WHITTLESEY HOUSE HEALTH SERIES

MORRIS FISHBEIN, M.D., *Editor*

The Back and Its Disorders

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by

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THE BACK AND ITS DISORDERS

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Preface

THIS BOOK is written for the guidance of the general public rather than for doctors, nurses, physical therapists, and occupational therapists. Persons who either have backache, have had it, or are candidates for it, as well as those interested in relatives or friends who suffer from disorders of the back, will, I hope, read it. This book, however, is not intended to, nor will it, prepare anyone to diagnose or treat his own case or that of another. It tells about the anatomy and physiology of the back as an integral part of that greatest of all machines, the human body.

About twenty years ago I was asked to write a small book on posture and hygiene of the feet for the public. At the end of six weeks of procrastination because of my doubts, I called Dean Irvin S. Cutter of Northwestern University Medical School and read the request to him over the phone. He listened attentively. When I asked his opinion, he said sharply, "By all means, do it. The public is entitled to authoritative information." I remembered his words when I started my work on this book.

Almost everyone has misconceptions regarding the functions, dysfunctions, and disorders of the back. I hope that when the reader finishes this volume, he will have replaced those misconceptions with a clearer knowledge of what constitutes the back, what can go wrong with it, and what he and his doctor can do to prevent and correct disorders of the back.

No other part of the body offers more interesting problems, partly because disorders of the back lend themselves to precise

diagnosis, localization, and treatment and partly because they are so common. Colonel Spurling, of the Office of the Surgeon General of the United States Army, stated (and my own experience confirms) that problems of the back were the most serious of all during the basic-training period in the Army. They are equally common and serious in industry and business.

Readers will find out why backache is such a widespread medical problem, and they will learn about the latest methods of treatment. Perhaps most important, they will discover some of the simple procedures that they themselves can follow to reduce their chances of developing disorders of the back. Early recognition of the causes of such disorders will minimize pain and disability and will prevent or restore impaired usefulness. The patient must seek medical advice promptly when symptoms appear. The close cooperation of various specialists with orthopedic surgeons has added much information to the diagnosis of troubles related to the back; this makes the patient's outlook today more promising than it has ever been before.

Backache is any discomfort that originates in or around the bones, joints, ligaments, muscles, fasciae, nerves, and blood vessels of the back. Secondary backache means pain produced by or in other tissues or structures and referred to the back through the nerves. Flat feet, knock-knees, bowlegs, or tilted pelvis may produce secondary backache. So may focal infections in the gastrointestinal, genitourinary, or respiratory systems.

No one sign or test is positive proof of a certain lesion or disease of the back; no one test "makes or breaks" the diagnosis; no one test determines the exact localization of a lesion or injury. Instead, many tests must be used; the patient must give a careful history, and X-ray pictures must be taken. Only after many investigations have been made can an accurate diag-

nosis be expected. Even then, differential diagnosis may be difficult. Similar symptoms may be produced by almost incredibly dissimilar causes.

The outlook in disorders of the back depends on the causative factors, the abnormal changes, duration of the condition, cooperation of the patient, persistence of treatment, the question of financial or other compensation, and the degree of involvement of the spinal cord and nerves. Injuries of the back are sometimes followed by nervous symptoms out of all proportion to the severity of the injury. Generally speaking, back injuries, even to normal spines, require a longer period of recovery than injuries to most other joints. As in most other illnesses, however, the outlook in spinal conditions is now more hopeful than it has ever been before.

I would like to express my gratitude and appreciation to all of those who have helped in the preparation of this volume: to Dr. Morris Fishbein, Mrs. Kathleen Simmons Ray, and Mrs. Beulah Phelps Harris, for editorial assistance; to the medical artists, Dr. Harold Laufman, Miss Lucille Cassell, and Tom Jones, for illustrative material; and to the following publishers and publications for permission to use various photographs and drawings—S. H. Camp Company, W. B. Saunders Company, Lea & Febiger, and *Hygeia.*

PHILIP LEWIN, M.D.

Contents

Foreword

DOWN THROUGH the ages the body of man has changed. The anthropologist, Estabrooks, speaks of modern man as a mechanical misfit. Over a period of ten or fifteen million years the skeleton has changed. All animals were originally four-legged beasts. Some, like monkeys, began hopping around on their hind legs. Today man is the only animal that really walks and keeps his body erect. Early men always walked with a decided stoop and, when not stooping, leaned forward on a club or a cane.

The change in the posture of the animal made it necessary for certain portions of the body to change, and some of our troubles arise from that fact. Consider the backbone, the value of which lies in its flexibility. If it is absolutely rigid, it is impossible to bend or move or see well or do any of the many things that a human being can do because his back is flexible. Therefore, nature never provided for the development of man with a rigid spine. Instead, his spine is a spring, somewhat curved like the letter S. The top bulge of the letter S forms the round shoulders that occur in many human beings. The bottom of the letter S is the hollow of the back.

As human beings get older, this spring breaks down, as do other springs. The shoulders become stooped; the hollow of the back first straightens out and, as Estabrooks says, "then hollows the wrong way." In other words, as the peculiar structure of the human spine changes with age, it comes to resemble more and more that of an animal that walks on four feet instead of two. It forms an arch instead of a spring.

When we are young, it is possible for the back to be a self-regulating mechanism. We know that no spring made by man will last for seventy years. In fact, springs in motor cars, which are subjected to much less strain than the seventy years of human life, break down in less than one year in many instances.

"Low-back pain" is one of the most frequent complaints of people past their youth who consult physicians. A pain in the back is not like a pain in the throat, which can be quite definitely related to changes that are seen. So many different possibilities prevail that the doctor's learning and diagnostic skill are taxed to determine exactly the cause of the sensation. For this reason, patients with "low-back pain" are sometimes subjected to operations, placed in plaster casts that immobilize the joints, sometimes given injections of local anesthetics to relieve the pain, sometimes submitted to the effects of heat by the use of the infrared lamp, the hot-water bottle, or diathermy, and sometimes treated with various drugs, vaccines, or other preparations.

Pain is frequently a reflection of stress or strain on tissues of the body. If there has been any extraordinary pulling or tearing of tendons or the attachments of muscles such as occurs, for instance, by the sudden twisting that occurs in swinging a golf club or in a motor accident, simple rest of the affected portion until healing occurs may be all that is necessary. In other instances, however, long-continued bad posture, overweight, or similar forces may exert a continued pull on the tissues, resulting in deformities that are associated with pain. Quite recently physicians have discovered that the cartilages that act as cushions between the joints of the spine may be pushed out of place or damaged, with pain in the back on the slightest motion. Occasionally pain in the back results from difficulties elsewhere in the body, as, for instance, in the sciatic nerve.

Fortunately for mankind, the back has developed so well that it is capable of withstanding stresses and strains better than many other parts of the body. There are some who insist that the back is the weakest part of man. Actually, it is one of the strongest and best. If it could be given the same amount of personal consideration and attention that we give regularly to the teeth, the skin, and other portions of the body that are more easily visible, the human body would be a more efficient working mechanism and one that would last much longer without breaking down.

MORRIS FISHBEIN, M.D.

CHAPTER I

What Goes into Your Back—and What Comes out of It?

LIKE THE REST of your body, your back is composed of bones, muscle, ligaments, nerves, and blood vessels. Unlike the rest of your body, it contains also a spinal cord and the roots of many nerves, which branch out to all parts of your body and control organs and functions far away from their places of origin. Again, as in other parts of your body, the widely varying elements that make up your back have arranged themselves in shapes and sizes astonishingly well suited to the job they have to do.

The bones of the back have taken the form of *vertebrae*—twenty-four of them—and of a *sacrum* and *coccyx*. Each single vertebra contains two parts—the body (a solid piece of spongy-textured bone, the part that bears weight) and the spinal arch (which forms an opening through which the spinal cord passes and by which it is protected). The spinal arch, in addition to its job of housing the cord, is equipped with five bony fingerlike projections, to which the muscles and ligaments of the back are anchored. You can easily locate the center projections, called spinous processes, with your finger. They are the little bumps you feel up and down the length of your spinal column. One, at the base of your neck, is often quite prominent. Adjoining vertebrae are attached by joints that project up and down from each vertebra's spinal arch.

Between the bodies of each two vertebrae, and helping the

spinal arches hold those vertebrae together, is an intervertebral disk, a cushion composed of an elastic outside layer and a semi-fluid center. The disks act as buffers, which make it possible for you to bend your back, to stretch, and to move around generally in comfort. The size and thickness of each disk is closely related to the amount of mobility expected of the area of the back in which it appears. In an area where little motion is needed or is possible, disks are small. Where the spine must be very flexible, as at your neck and waist, larger disks are found.

Probably the greatest value the disks have is their ability to absorb the shock of your footsteps and to prevent your brain from being jarred violently with every step you take.

The vertebrae are not attached to each other haphazardly, nor do they merely make a long, straight, uninteresting column. They are arranged to form well-defined curves, curves that strengthen the spine and make it more elastic and help the disks cushion the brain. The curves are also situated so that they increase the size of the chest cavity, and since they are gradual, it is possible for the column to house the spinal cord and still eliminate any danger of compressing it. Last, but certainly not least, they add to the beauty of the body's outline.

At the top of the column, at your neck, is a forward curve. It is known as the cervical curve and is composed of seven rather small cervical vertebrae. Immediately beneath it, and bending backward, is the thoracic curve, with twelve thoracic vertebrae. Following this is the lumbar area, curving in toward the abdomen again (more deeply in women than in men) and containing five vertebrae. There is, therefore, an alternating concave-convex series of front-to-back curves. You can identify them easily by looking at your profile in a mirror. The vertebrae

are numbered from the top down—the first thoracic vertebra is the one below the seventh cervical.

Below the lumbar region is the sacrum, in reality a single bone, although it is composed of five sections that have grown together. At the very end of your spinal column, and attached to the sacrum, is the coccyx, or tail bone, a tiny, triangular bone made up, like the sacrum, of four vertebrae that never completely developed. At the top, your spinal column joins your skull, and at the bottom, by means of the sacroiliac joints, it is attached to your pelvic bones.

You are not born, however, with these curves all efficiently mapped out. The spine of a newborn baby is actually one single backward curve, like that of the bow used in archery. But as the baby begins to sit erect and to lift up his head, the resulting pull on the vertebrae of his neck and the need for greater spinal strength cause the cervical curve to appear. And when he begins to stand and to walk, pulling his legs out straight, the lumbar curve takes shape. With old age, the spine begins again to assume the single-curve form. There's more truth than poetry in those remarks about "second childhood."

It is just as well that you do not have to depend on the intervertebral joints exclusively to hold your vertebrae together and to make your spinal column keep its shape. The true binding materials are the strong, tough ligaments, which extend from the head to the sacrum and which envelop and lash all the vertebrae and the intervertebral disks together. Ligaments are an extremely important part of the anatomy of the back. In the sacroiliac region, particularly, they afford a tremendous amount of support. Woven back and forth through the area, they cushion and strengthen the almost immovable sacroiliac joints.

One of the main functions of the vertebrae, and of the spinal column they form, is to provide a channel for and a protecting wall around the spinal cord. While a baby's body is developing in its mother's uterus, this spinal cord takes up the entire length of the column, but even before birth the column begins to grow faster than the cord. By the time the baby is born, the cord ends on a level with the third vertebra in the lumbar area, and when he reaches his full growth, it has shrunk up to the level of the first lumbar vertebra. The cord ends in a number of thread-like filaments, which continue down the column and fasten the cord to the coccyx. At the top, the cord merges almost unnoticeably with the medulla oblongata, the nearest section of the brain.

The spinal cord and brain are the centers in which your nerves originate—nerves without which you would be simply a helpless mass of tissue, for the nervous system is a vital factor in governing every move, every reaction, every function of your body. Unless the proper nerves are functioning uninterruptedly from the muscles of your legs to their roots in your spinal cord, you can't walk a step—you are paralyzed. If the nerves that end in the skin of your hand aren't in good working condition, you won't feel the pain when you touch a lighted match to your hand.

A nerve is a cordlike structure that conveys impulses from one part of the body to another. If you prick your finger with a pin, the sensory nerve located at the pricked spot immediately sends an impulse back along its entire length to your spinal cord (the switchboard) announcing that a painful stimulus has been applied to the specific finger in question. Instantly—so rapidly, in fact, that you cannot be aware that all this is taking place—an impulse is sent out by way of a motor (meaning motion) nerve,

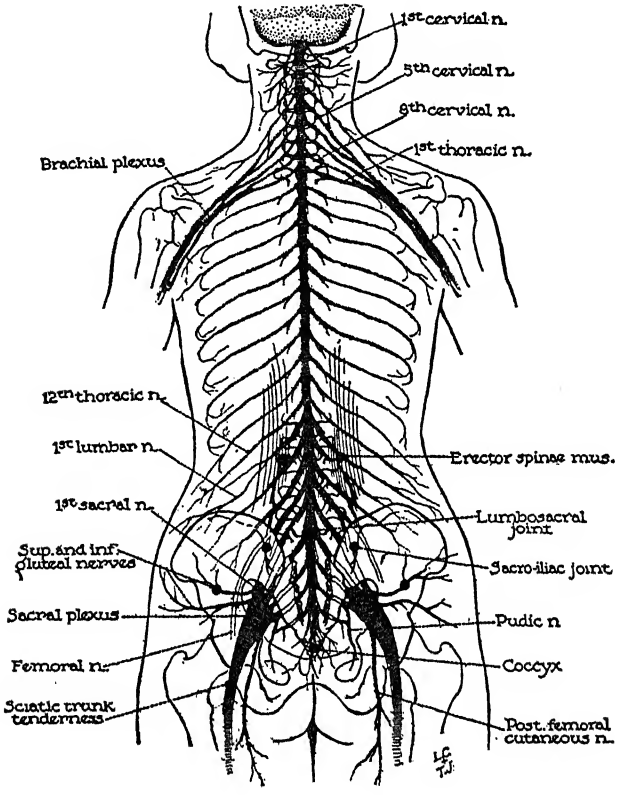
and your hand is jerked away from the pin. These two functions, to *feel* and to *act*, are what make your nerves so all important.

Two roots anchor each of the spinal nerves to the spinal cord. The motor root is attached to the front part of the cord; the sensory root is attached to the opposite side. The two roots converge to form a single spinal nerve, either in or near the *vertebral foramen.* The foramen is the opening made by the spinal arch, and it is through it that the nerve leaves the spinal column on its way to the particular area that it serves.

The last important component of the back is the muscular system. Back muscles have two functions—to maintain correct posture and to produce movement. Under normal circumstances, the muscles can be expected to keep the body in correct position without any conscious effort on your part and without fatigue. They do not do this alone, of course. The front-to-back curves of the spinal column, which strengthen it enormously, enable the column to transmit the weight of the trunk to the pelvis and reduce the necessity for muscular effort in maintaining posture. Nevertheless, cooperation between muscles and bones is necessary. If your muscles, because of some weakness, fail to do their part, you must help your spinal column hold you erect by voluntary muscular effort—which leads to tired muscles and pain.

The muscles work with the nerves, tendons, bones, and joints to produce movement. Muscles located on both sides and in front of the spine permit it to flex by contraction. Pairs of muscles located behind and on both sides of the spinal column enable it to extend. An elaborate system of muscles attached to the vertebrae help the ligaments hold the vertebrae in their proper places when the body is at rest and allow them to move when the body is in motion.

In the normal back there is perfect balance between the muscles of the back on one side and those on the other. If, for any reason, the muscles of one side become weaker than the opposing muscles, the spinal column will become warped. The stronger set of muscles will pull it out of normal line and a spinal curvature will develop.



Relation of posterior spinal nerves to cervical and lumbar vertebrae with indications of important landmarks and other structures. (Redrawn and modified from Tom Jones, courtesy of S. H. Camp & Company)

CHAPTER II

Why an Aching Back?

THERE ARE so many reasons why people have backaches that trying to compile them is an almost endless job. Even on one particular backache there's likely to be a great deal of disagreement about the causes, or the etiology, as doctors say. A list of the reasons why people come to doctors begging for relief from pain in the back can be expanded to include almost every known disease and injury.

Nevertheless, the causes of backache can be classified roughly under three headings: (1) those caused by disease; (2) those caused by mechanical difficulties; and (3) those caused by injury. It can't be said too emphatically that backache is always a *symptom.* If you have pain in your back, something is wrong somewhere in your body.

The *diseases* that can result in back pain may be traced to almost any part of the body. The spine is by no means the only evildoer. Among the actual spinal diseases that cause backache, however, may be such infections of the spine as arthritis, tuberculosis, or osteomyelitis (inflammation of the bones). Tumors, either of the bone or soft tissues of the back, syphilis, and meningitis affect the functioning of the back, too. Diseases of the nervous system, such as neuritis, sciatica, meningitis, encephalitis, and poliomyelitis, are also directly responsible for many painful backs.

Diseases in the organs near the spinal column often cause back pain. Everyone knows that backache accompanies disorders

of the kidneys. The whole urologic system, because of its proximity to the back, is responsible for much pain. In addition to such troubles in the kidney as infection, tumors, or stones, the bladder and ureter may cause back pain when they become infected or become the harborers of stones. Backache in men is sometimes the result of infection of the prostate or seminal vesicles. Other abdominal infections that may result in backache are duodenal or gastric ulcer, colitis, and appendicitis.

Focal infections, like diseased tonsils or sinus or abscessed teeth, may cause backache because of the toxins that they generate and spread through the blood stream to the spine. Diseases of the upper respiratory tract, the lungs, and the pleura, diseases of the blood (such as pernicious anemia) may, in spite of their seeming remoteness from the back, cause pain in that region.

Bad posture is one of the most common *mechanical* causes of back pain. It will be discussed at length in a later chapter, but it should be mentioned here that faulty posture, in which the curves of the back are allowed to become exaggerated, results in round shoulders and sway-back. Back pain occurs not only because the shape of the spinal column has been distorted (with consequent weakening and lessening of its ability to carry a full load) but also because the distorted spine crowds the internal organs out of their natural position and makes it impossible for them to function with maximum efficiency. Women are subject to backache both during and after pregnancy, largely because of posture. The displacement of the reproductive organs, which sometimes occurs after delivery, may cause severe back pain.

Congenital defects of the spine, such as misshapen or displaced vertebrae or variations in the lumbosacral angle, cause backache. Deformities of the feet and inequality in the length of the legs are other mechanical difficulties that should be included

in this list. Disturbances in the endocrine glands—the thyroid, parathyroid, pituitary, adrenals, or gonads—are causes of many backaches.

The *injuries* that result in temporary or chronic backache may occur at home, in industry, on the farm, in athletics, or in other places or fields of bodily activity. They may be injuries to the vertebrae—either fractures or dislocations—injuries to the intervertebral disks, to ligaments, muscles, nerves, or skin. Such a simple act as raising a window that sticks, missing a step on stairs, rising suddenly from a stooped position, reaching for an object that is too high, lifting a heavy child from side to side, shoveling snow, or sneezing while sitting in the bathtub with legs outstretched may result in an injury that will cause backache.

In industry, blows, falls (especially on the buttocks and coccyx), muscular strain from working with ill-placed equipment, lifting heavy objects, or lifting with the stress wrongly placed on the back rather than on the thighs and legs may result in back injury and consequent pain. Doing the wrong kind of work for one's build and strength is hazardous. Occupational back injury isn't limited to industrial workers. A surgeon may emerge from the operating room with a backache after operating for a long time in a cramped position. A dentist may develop backache after long hours of standing beside his chair. Many a stenographer has injured her back by shoving her desk around. Pain from strained ligaments and muscles is common among librarians, who put too much trust in their backs when reaching for books on high shelves. In fact, hardly a vocation can be mentioned from which the orthopedic surgeon cannot cite an example of back injury.

Athletic injuries are very common. In football, kicking at the

ball causes many back injuries. Baseball, tennis, bicycle riding, and diving all carry their hazards to the back. People have even suffered back pain after picking up grass on the golf course to see which way the wind was blowing!

All these activities have caused backaches and will cause more. The ligaments of the back may be stretched or torn; muscles may be strained or stretched when their owner carelessly calls on them to do a task that is too much for them. Any injury to any muscle, no matter how small, often results in great pain.

All branches of medicine are coming gradually to recognize the importance of the psychosomatic factor in disease, and orthopedic surgery is no exception. So it must be included here as a cause of backache. The word "psychosomatic" implies a relationship between the emotions and the body functions. Functional psychosomatic backache is recognized in many cases. In the armed forces it was often considered to be malingering, and among certain groups of people it is recognized as hysteria.

We will have more to say later about all these causes of backache. Right now there are a few constructive things that may be said about ways to avoid some of the conditions that bring on backache.

The basic preventive health measure, which stands as the rock-bottom rule for avoiding backaches, is good general health. Adequate nutrition and sleep, fresh air, exercise, and regular physical examinations, all the old recommendations with which physicians have sounded the trumpet for years, go into the maintenance of a good physical condition.

As far as the backaches that can be referred to some organic disease are concerned, the basic recommendations for early detection and prompt treatment still hold. Focal infections, such as diseased teeth or tonsils, should be corrected before they have

a chance to do harm. The periodic physical examination plays an important part here. The really serious infections, like tuberculosis or arthritis or kidney disease, will usually provide a number of symptoms, so their victim will hurry to a doctor to find out what is wrong. But the mild, general infections frequently have to be sought out by an expert. Who would have thought that that aching back was due to an abscessed tooth?

In preventing the backache caused by mechanical difficulties, the physical examination is vital. Even a routine examination generally shows up postural difficulties, and the person with unhealthy posture can do a great deal, with proper guidance, toward correcting it and eliminating postural strain. Employers can spare their employees much discomfort (and themselves a number of lost working days) by providing proper seating and lighting equipment. The National Safety Council cites the case of the United States Navy, which was having trouble with back strain among its draftsmen. Backaches disappeared when the Navy increased the tilt of the drafting boards by 30 degrees.

Prevention of fatigue is a factor in backache, too, since fatigue has much to do in promoting bad posture. Sticking to work that is not too heavy for his strength will help the worker avoid fatigue, and the employer can see to it that employees are given work suitable to their body builds.

Mechanical difficulties of a congenital nature—that is, abnormalities of the spine—may not be detected in a routine physical examination, but a more detailed checkup, with complete and carefully studied X rays of the back, will generally reveal them.

The safety measures that should be observed in any home, factory, office, or athletic contest will, if carefully and conscientiously observed, help to reduce the risk of spinal fractures and other bone injuries, as well as joint, ligament, and muscle in-

juries. Equipment—especially stepladders, moving machinery, and so forth—should be kept in good repair. Floors should always be dry and unlittered and, at home, not highly polished. In games like football and baseball, proper equipment and strict adherence to rules help diminish the risk of back injury. These are only a few of the safety rules that, if conscientiously observed, would reduce the hazards to our backs.

CHAPTER III

What's the Matter with Me?

YOU ARE CARELESS, so you decide not to see your doctor about that low back pain or that stiffness on arising until it gets to be just a little too much for you to handle by yourself with any degree of comfort. When you *do* visit him—and it's much better for both you and him if you do it as soon as you become aware of any symptoms—he'll want to follow certain very definite lines of procedure in diagnosing your case. Diagnosing back disturbances is a complicated matter, since a number of different conditions exhibit the same or similar symptoms. Then, too, the doctor has to consider not only the back, with its bones, joints, ligaments, muscles, nerves, and other tissues, but also the organs of the abdomen and pelvis.

When you visit your doctor and ask for advice on your back troubles, he will want, first, to take a complete history of your case. The part you play in history taking is just as important as his, because the more you remember to tell and the more accurate your information, the more complete the history will be and the more it will help in the diagnosis.

Your symptoms were the reason for consulting the doctor. The most important symptoms of back disturbances are discomfort, deformity, and disability, and you probably complain of one, maybe all three, of these. You describe the kind of discomfort you experience (constant or intermittent), locate it (high, low, or middle back), and tell when it appears (many people experience discomfort only when they resume activity

after a period spent sitting or lying still). Deformity, if it is pronounced at all, is noticeable, although certain tests are needed to establish it definitely, just as tests are used to find out the extent of your disability. Fatigue and weakness are other frequent symptoms of back trouble that should be mentioned, if you have experienced them.

How long have you been having symptoms? If you have had back trouble and treatment earlier, you should describe both and tell the doctor how successful the treatment was. If this is your first attack, did it come on suddenly or gradually? If other members of your family have had back troubles, what about them? Tendencies toward certain back weaknesses can be inherited. Your occupation may offer a clue to your difficulty, and the doctor will want a description of the sort of work you do, especially if it requires a great deal of lifting, stooping, stretching, or sitting for long periods.

Finally, in taking your history, your doctor finds out as much as he can about your general health—the condition of your teeth, nose, sinuses, throat, gastrointestinal tract, and genitourinary system. Any information on recent or old diseases or injuries you may have had is interesting to him. You will probably slip up on this question if you are like many patients. It may take a lot of prodding from the doctor before you remember about that fall two years ago. Yes, there was pain in the lower back for two or three days after that, but it went away and you forgot about it. Such information as this is very important and should not be overlooked.

The history taking is usually followed by examination, the physical examination generally coming first. For this, a minimum of clothing should be worn.

First the doctor will examine your back while you are stand-

ing. He will check your posture, your weight (obesity plays a considerable part in backache), and the specific location of your pain. He looks for any swelling, discoloration, tenderness, abscess, or other external sign, checks your breathing, and measures your chest expansion. The extent to which you are round-shouldered or sway-backed interests him, as do many other small anatomic signs recognizable only to a doctor. He will inspect your feet from the front and back and will study your walk. He will ask you to bend over, to flex your back (that is, touch your toes), and then to extend it (in exaggerated military style). This shows how far you can move it in every direction and at what point pain or muscle spasm occurs, and it points out any areas of rigidity that may exist. The same procedure is repeated when you are sitting up.

Next he may ask you to lie down on your back on the examining table. A number of tests can then be applied to see just how far your back trouble has caused you to depart from normal ability to move before pain, spasm, or stiffness occurs. If you are lying straight out on a table, it should be possible for the doctor to raise one of your legs slowly to a right angle with the table before the movement is halted by pain, muscle spasm, or a compensating shift of the buttocks. If he applies this test to you, holding one hand under the lower part of your spine, and finds that you experience pain before the lumbar area of your spine begins to move (in an effort to compensate for the extended position of the leg), he will undoubtedly suspect either that you have arthritis or that some of the ligaments in the sacroiliac area are sprained. If, however, pain does not come on until *after* the lumbar spine begins to move, he will suspect disease or injury in either the sacroiliac or lumbosacral region; his preference will be for the lumbosacral area. He can make

this diagnosis definite by having you repeat the same movement with your other leg. If the disturbance lies in the lumbosacral region, you feel pain when the second leg is lifted to the same height as the first. If it is sacroiliac, you are able to lift your leg much higher on the side that is least involved.

Another of these tests (most of which are called by the names of the doctors who invented them) determines the area of the back most involved with lumbar arthritis or sciatica; another indicates the presence of sciatica; another helps in the diagnosis of vertebral injuries; and so on through a long list.

The doctor will probably make a number of tests while you are lying on your back; then he will ask you to turn over on your stomach while he performs some more diagnostic exercises. He can locate a spinal lesion while you are in this position, by having you lift your head and extend your back as far as possible without using your hands to help. The point at which you yelp with pain or at which your muscles suddenly and involuntarily contract in a spasm tells him where the difficulty lies.

If he thinks he knows the disease or condition troubling you, he will probably apply the specific test that identifies it. The test will either corroborate or refute his theory and may save much time in diagnosis.

Rectal examination often tells the doctor a great deal. Disturbances in the coccyx and the lower portions of the sacroiliac joints, such as deviations from proper position or tenderness on pressure, may be discovered in this way. In men, rectal examination supplies information about the size, consistency, tenderness, and secretion of the prostate and seminal vesicles, both of which can cause severe backache. In women, vaginal examination helps the doctor discover any tenderness or other unex-

plained disturbance around the sacroiliac joints and the sacrum and also any lesion of the pelvic organs.

Your doctor will probably give you a neurological examination to find out if your spinal nerves are working properly and if your condition might be due to faulty nerve function. He determines what control you have over your feet by asking you to bend your toes, turn the soles of your feet up, and so forth, first passively and then against resistance. He finds out whether or not you can feel the touch of a hand on all areas of your skin, whether or not you can recognize, by the feel, the sharp or dull end of a pin, whether or not you can tell the difference between the stroking of a finger and of a piece of cotton, and whether you can differentiate between the touch of a test tube containing ice water and one containing hot water. In addition to your sensations, he will also test your reflexes.

This completes your physical examination, but your doctor hasn't exhausted all his diagnostic resources by any means. Samples of your blood and urine go to the laboratory for analysis, unless you have come to the doctor with some easily recognized injury. Your blood is tested for the red and white blood-cell counts and for its chemical, bacteriologic, and serologic status. Your urine is examined physically, chemically, and bacteriologically. The doctor may even send a sample of your spinal fluid to the laboratory for analysis, especially if he suspects that you may have poliomyelitis, meningitis, or syphilis. If he suspects tuberculosis or tumors of the spine, he will try to obtain samples of tissue to be analyzed to determine whether tubercle bacilli are present or whether the tumor is benign or malignant. This is called a biopsy report.

He will, in all probability, take X-ray pictures of your back from various angles. By means of the shadows that show up on

the film he can recognize changes in the position, density, shape, and structure of your vertebrae, whether they are smaller or larger than normal, and whether or not disease has caused them to harden excessively. He can even examine individual vertebrae for size, shape, alignment, the size and shape of the intervertebral disks, and the condition of the parts. X rays are a valuable aid in diagnosis.

Now comes the time for the doctor to look over his notes on your history and physical examination, to study the laboratory reports on your blood, urine, spinal fluid, and biopsy tissue, and to ponder over the shadowy X rays. In following this procedure so far, he has been sending out feelers, which have groped around (though not just at random) picking up all the information they could about the state of your spine—and, indeed, the rest of your body.

With many patients, a single one of these feelers would have collected enough information to tell him what the trouble was. But your case was more complicated, and he has used almost every technique he knows to make sure of an accurate diagnosis. Now he must correlate the findings of the different feelers. When he has finished, he should have the answer to the riddle of your backache.

It often happens, however, that two totally different back conditions resemble each other in many ways, and it may be that in your case, even after a study of all the information he has collected, he still is not sure which of two evils is victimizing you. In this event, he has to look for some small but specific difference to tell him which disease or condition to attack. He may be undecided as to whether you have tuberculosis or cancer of the vertebrae. (True, I might have chosen two less frightening diseases, but these offer an excellent sample for differential

diagnosis.) If the intervertebral disk has become involved, he might suspect tuberculosis. If the disks are normal, he might have to rule out cancer.

Diagnosis is sometimes an involved and extremely difficult procedure. But given skill, adequate equipment, the facilities of a good laboratory, and the cooperation of his patient, the doctor is almost sure to come up with the solution to the problem of what's troubling his patient.

Then both are faced with the biggest question of all: What to do?

CHAPTER IV

What Can You Do, Doctor?

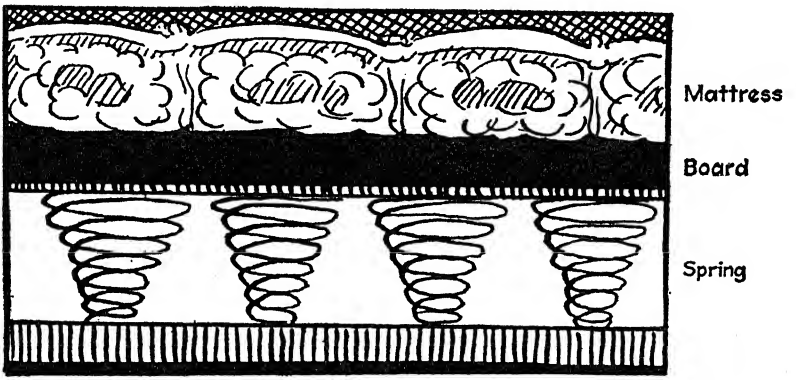
WHEN DIAGNOSIS has been completed and the nature and causes of a back disorder determined, the minds of a doctor and his patient turn to methods of treatment.

There are two broad, basic methods of treating back disorders —operative and nonoperative. Under each of these headings are many specific methods, applicable under different circumstances and with different disorders. All of them aim first to correct the disorder and then to prevent its recurrence.

Naturally, many more back disorders are treated nonoperatively, or conservatively, than by surgery. Nonoperative methods of treatment may be applied by the patient, his family, or his doctor at home, by the doctor in his office, or by the doctor and technicians in the hospital.

If the patient is being treated at home, his disorder either may be severe enough to require him to remain in bed all the time or may allow him to be up at least part of the time, helped by a cane or crutches. In some cases a rigid mattress will be necessary, and in others a specially built frame may even be required. The doctor or a visiting physical therapist, and sometimes even a member of the family, may give local applications, massage, or heat treatment. The patient with back trouble should always be protected from drafts. Supports are often useful. Some types of supports are similar to a scientifically planned corset. Others are almost like cages and are made of leather or steel or a combination of the two.

When the patient is being treated by the doctor in his office, more extensive measures may be used. The doctor may give him local injections or physical therapy during his visits. His diet may be watched (and his weight reduced when necessary) and thiamin chloride is often prescribed. The frequently necessary braces may be fitted or the patient's pelvis strapped with adhesive.



Simple way to make a mattress rigid—insertion of board under mattress. (*Lewin, Backache and Sciatic Neuritis, courtesy of Lea & Febiger*)

If the patient's condition is serious enough to warrant orders for complete bed rest, or if he has no one to take care of him at home, he is generally better off in a hospital, where he can be studied carefully and where special measures can be carried out whenever a new situation arises. A rigid mattress is practically always used in hospitals for patients with back disorders, and a bed frame is often required. Focal infections, such as those in teeth, throat, gastrointestinal tract, genitourinary tract, and prostate and pelvic organs, are treated. Hemorrhoids and constipation are corrected as fully as possible, and if the patient is ex-

cessively overweight, he may be put on a reducing diet. Plenty of rest is important for all patients.

There are few back conditions that can be treated by taking pills or shots of something, but there are a number of pills and injections that are valuable in relieving the pain that nearly always appears with any back disorder. These vary greatly as prescribed by individual doctors—particularly the substances to be injected and the sites chosen for injection. Nerves, ligaments, or muscles may be injected, and normal salt solution, novocain, and atropine are among the substances frequently used.

Supports are valuable in treating many back disorders. They are used to obtain either leverage or pressure to prevent the patient from making movements that will cause him pain. Adhesive plaster strapping is generally the first kind of support used. It is excellent for relieving many kinds of low back pain. After the adhesive strapping has been in position for from four to ten days, the doctor may change it in favor of a belt, brace, corset, or bandage. There are many, many different kinds of these, and the doctor has wide leeway in choosing the one best suited to a specific disorder. One type of brace is used most often to correct poor posture and to prevent permanent spinal curvature after poliomyelitis. An orthopedic corset is especially good when the lower back needs support.

Often it is necessary to apply traction. This is done by weights attached to straps and suspended from the part of the back or neck that needs treatment.

Physical therapy plays a prominent part in the treatment of many spinal disorders. In fact, there is no section of the body that benefits more from physical therapy. Some of the most painful and disabling disorders of the back and neck may be relieved, and even cured, by physical treatment. It stimulates the

local and general blood circulation, aids in local absorption of tissue products, gives relief from pain, helps spastic muscles relax, aids in breaking up adhesions, increases the patient's resistance, and brightens his psychological outlook.

One of the best physical agents is heat. Dry heat may be obtained from a hot-water bag, hot sand, hot brick, electric light, electric pad, baker, infrared lamp, electric-light cabinet, or sun. Ointments, liniments, and plasters produce chemical heat, and moist heat is obtained from hot applications, steam, or mud baths. Ice bags, cold applications, contrast baths, sprays, and applications (of heat and cold alternately) are useful in some cases. Local application of heat causes the muscles and the walls of the blood vessels to relax, and, consequently, relieves muscle spasm and allows an increased flow of blood to injured or infected tissues. Cold applications help reduce the elevated temperature often associated with certain injuries to the back. In some conditions, especially arthritis and neuritis, artificial fever, produced by hot baths, vaccines, or diathermy (the use of a high-frequency current to generate heat), is helpful.

Skilled massage, especially when given immediately after treatment with heat, is frequently effective in cases of sprains and strains. Its chief value is in improving the circulation in the affected area, but it also helps to compensate for the lack of muscular activity, which can be very serious when a patient must lie in bed for a long time. But massage should not be attempted except by a specially trained person, working under a doctor's orders. Used improperly, it can aggravate a back disorder.

Hydrotherapy, or the application of water, increases the circulation of blood in the skin and has a tonic effect on the nerves. Shower, needle spray, hose spray, bath, sitz bath, or whirlpool

bath, with hot, warm, cool, cold, or alternating temperature of water, may be used.

For its aid in toning up the system and slowing down muscle atrophy, electrotherapy, or the application of electricity, is an important agent of physical therapy. Diathermy is valuable partly because of its power to localize the effect of a previously administered drug. That is, the doctor can give his patient a drug through the veins or by mouth and can then use the electric current to cause the drug to act only in the part of the body that needs it. Diathermy also increases metabolism, promotes healing, and relieves pain.

Heliotherapy (treatment by means of the sun's rays) and phototherapy (treatment by various lights) are auxiliary aids. Infrared and ultraviolet rays, or both, are valuable particularly in treating tuberculosis, rickets, osteomalacia (softening of the bones), and arthritis. Infrared rays are merely heat rays and harmless; ultraviolet rays may be dangerous unless they are handled scientifically.

Medical gymnastics assist in muscle education and reeducation and in muscle-power building. Some of the movements are carried out by the patient alone, some are performed by the therapist, and others are performed by the patient against the therapist's resistance or by the therapist against the patient's resistance. Patients with polio, spinal curvature, arthritis, bad posture, or conditions involving nerves and muscles are especially benefited by medical exercises.

Occupational therapy, the science of prescribed work, treats the patient by keeping him physically and mentally occupied. Generally, the doctor tells the therapist about his patient's case and shows him the muscles or joints that need exercise. The therapist then recommends the specific work that will train those

muscles or joints. Occupational therapy is psychologically as well as physically valuable, especially with patients who fear complete disability.

Treatment by X rays and radium has an important place, particularly in cases of vertebral tumors, arthritis, synovitis (inflammation of the membrane lining the joints), bursitis, neuritis, osteomyelitis (inflammation of the bones), osteomalacia, Hodgkin's disease (a glandular enlargement), and tuberculosis.

Manipulation aims to restore function to bones, joints, muscles, tendons, and ligaments without surgery. It is a delicate procedure and one that requires great care in practice, since errors may have serious consequences. When applying manipulation, the doctor moves the bones, joints, and muscles of his patient's body in order to stretch shortened muscles and tendons and to break adhesions and loosen up tight, fibrous tissues. Both of the last two cause stiffness in the joints of the back. Since complete relaxation on the part of the patient is necessary, anesthesia is often used, particularly when the patient is in great pain. Manipulation is never used with a patient who has tuberculosis, osteomyelitis, acute infections, acute arthritis, disorders of the intervertebral disks, or tumors or with very old patients. It is most valuable with adhesions, in functional or hysterical cases, and in many of the conditions that appear some weeks after a back injury.

Force is not needed in manipulation. Gentleness, with skill to back it up, is much more important. The patient is prepared for manipulation exactly as he is for surgery, with a sedative first and anesthesia afterward. After he wakes up, it is important that he start making active movements immediately, even though movement may cause pain. The success of manipulation

depends on his cooperating by using his muscles immediately. The doctor says concisely, "Force the patient but not the joint." For days after the manipulative therapy the patient should do back exercises in the morning and in the evening to prevent the formation of new adhesions.

It may be that the complete diagnosis of a patient's back disorder has indicated that the best treatment requires surgery. In general, operations for back disorders aim at either decompression or stabilization. Many different types of operations may be used to accomplish these purposes.

In preparing himself and his patient for an operation, the surgeon uses all the techniques that are necessary in any other operation, plus some used only in the field of spinal surgery. Several days before the operation the patient is told to increase the carbohydrate content of his food—to eat extra sugar in the form of honey, ice cream, candy, fruit juice, and so forth. Immediately before the operation he is bathed, his back is shaved, and the area is painted with one of the antiseptic preparations. Complete asepsis is necessary; great care must be exercised by the surgeon, nurses, and assistants to see that all persons, furnishings, and instruments in the operating rooms are as free of any germs as it is possible to make them. The surgeon is so on guard against infection that during the operation he does not allow any instrument that has touched the patient's thoroughly sterilized skin to touch any of the inner tissues. He even uses forceps, instead of his fingers, to tie sutures. Many different kinds of anesthesia may be and are used. The type selected depends on the kind of operation, the condition of the patient, and the surgeon's particular preference.

In cases where some disease, injury, or congenital defect has so interfered with the activity of one or more of the vertebral

joints that any movement of these joints causes pain, operation generally aims at stabilization, by means of *arthrodesis*, or rendering the joints immovable. The surgeon reasons that if the patient is unable to move the painful joints, his back will cease to hurt.

Arthrodesis may be attained by fusion or bone graft. If fusion procedure is used, the surgeon, in an intricate operation, bares the vertebrae involved and by reshaping and moving them joins the edges of the two (or three or four) he wishes to fuse. If bone graft technique is used, the surgeon joins the affected vertebrae with extra bone, sometimes taken from the patient's thigh or hip bone. After either fusion or bone graft the vertebrae operated on will grow together, forming an immovable mass of bone that can give its owner no pain due to movement.

Laminectomy is the name of the operation that accomplishes decompression. In laminectomy parts of some of the vertebrae are removed and the spinal cord or its covering membranes (or meninges) are exposed. Laminectomy may be necessary in cases of fractures or dislocations of the vertebrae, inflammation or a disease such as meningitis, compression of the spinal cord through injury or disease, spinal cord tumors, and many other conditions that affect the cord.

In certain cases it is necessary to fuse some of the spinal vertebrae after exploring the spinal cord. In such a case, a laminectofusion, or combination of both types of operations, is performed.

Care of the patient after operation is almost as important as care before and during surgery. The patient must be kept free from pain and the hospital staff must see to it that he has adequate sleep and a proper diet. It is especially important that the

normal water content of the patient's body be maintained after spinal operation, and the hospital attendant supervises this. Surgical shock is watched for and whole blood or plasma is administered when necessary. Vitamin C is generally given to the patient soon after he comes out of the anesthetic.

CHAPTER V

What's the Outlook?

IF YOU BREAK your arm, the surgeon you visit knows exactly what to do for it and can tell you how it will heal, when the healing process will be complete, and what you can expect of your arm after it gets well. But if you break one of the vertebrae in your spine, the situation is much more complicated. A broken vertebra can cause pressure on the spinal cord, with resulting paralysis; it can cause trouble in the adjoining intervertebral disks; it can affect the roots of nerves situated close by; it can, in fact, cause you endless back trouble and can produce repercussions in other parts of your body. The same is true of any disorder or injury of the back.

This is one of the reasons why it is often difficult for the doctor to say exactly how soon you will be well, once you have suffered back trouble. There are other reasons. The original cause of the disorder affects the outlook, as well as the tissue changes that have taken place since the trouble first arose. The extent to which the spinal cord and nerve roots have become involved is important. The presence of spinal abnormalities before the injury or disease made its appearance has to be considered. Your own resistance and general state of health affect the course of the disorder, as does the length of time it has been present.

One of the most important factors in prognosis (predicting the outcome) is early treatment. The longer a condition has been present, the better hold it has on your body. The longer

you've borne your pain or your disability without asking a doctor about it, the poorer are your chances for early recovery. In the case of tumors, early treatment is always advisable, because late treatment is likely to be less effective.

Prognosis varies widely with different conditions. When it is a matter of injury—broken bones, strained muscles, or torn ligaments—the outlook depends on the severity of the injury, the degree of shock and amount of hemorrhage, and the presence or absence of infection. When it is a case of paralysis, the extent of the paralysis and the treatment employed determine the results. The success of surgery depends on the promptness in the performance of the operation and the technique used.

Naturally, in all these cases the cooperation of the sick person affects the outcome, too. His mental and emotional outlook can help or hinder treatment. More and more, doctors and their patients are recognizing that the human organism is not divided into two separate entities of mind and body. Each of these aspects is profoundly dependent on the other. One doctor says that 40 per cent of the organic disorders seen by physicians are at least partly the result of emotional disturbance. According to the same doctor, 80 per cent of the people who are treated for psychiatric disorders have organic disease associated. The course of any disease may be altered by the patient's emotional condition. In back disorders, too, nervous symptoms are likely to complicate the outlook and may cause disturbance after the original disease or injury has been cleared up.

Even in cases where cure cannot be promised, it is generally possible for the doctor to relieve pain, either by surgery or nonoperative treatment. After surgery, people are usually able to go back to their former occupations even when the work is heavy.

Each individual case of backache represents a different prob-

lem to the doctor. He will probably tell you what success you can look forward to, from treatment. If he doesn't tell you, it's more than likely that he just doesn't know. And if he doesn't know, you needn't take it for granted that he's a poor doctor. Medicine can go a long way in making sound predictions, but there are some cases where an accurate answer to the question, "How long?", is unpredictable.

CHAPTER VI

Mother Nature's Failures

TAKING A REASONABLE APPROACH to specific disorders of the spine, it is best to begin at the beginning—with congenital defects, or those that are present at birth. Most persons are born with almost perfectly developed bodies. When the infinitely complicated process involved in forming a fetus is considered, it is surprising that the number of defective infants is so small.

The back, as well as other parts of the body, may suffer from faulty development. Variations from the normal anatomy in the back nearly always weaken it, and while a defective spine may give no real trouble under normal stress, it is likely to break down under a slightly heavier-than-usual load. This is due largely to the fact that almost any developmental variation in the back leads to some restriction in the natural ability of the spine to move about. The principle that leads manufacturers to make flexible steel holds true in the human anatomy. The less flexible the back, the more likely it is to break someplace. Sprains of ligaments in the sacroiliac and sacrolumbar regions are the most common difficulties encountered as a result of congenital spinal defects and their consequent hampering of spinal movement.

One of the most frequently seen congenital variations of the spine is a reduction or an increase in the number of parts. Between 15 and 22 per cent of all living persons have numerical variations of one sort or another in their spines. Sometimes there are too many or too few vertebrae. The number of vertebrae

may be reduced because of improper union of the bones at either the upper or lower end of the spine. When *occipitalization* occurs, the first cervical vertebra merges with the occiput, the back of the skull. Like almost all congenital defects, this may be accompanied by a number of other deformities. The person who suffers from this particular defect is likely to have a short neck, and he may suffer from a deformed lower jawbone or from spinal curvature. When the anomaly occurs at the other end of the spine, the last lumbar vertebra may merge with the sacrum, or the first segment of the sacral bone may form an extra lumbar vertebra. This, too, is often accompanied by other symptoms. Variations in the number of parts at the upper (or cranial) end of the spine occur more often in women, for some reason, and caudal variations (at the lower end) are seen more often in men.

Occasionally a doctor finds a case of *accessory vertebrae*, in which one or more wedge-shaped extra vertebrae have appeared in the spine. They cause spinal curvature, almost inevitably, by disturbing the balance of the column. In addition to numerical variation, the vertebrae may show abnormalities in shape and position. The bodies, the transverse processes (the fingerlike side projections), or other parts may be misshapen. Sometimes they have grown too large and sometimes they are underdeveloped.

Abnormalities occurring in the ribs affect the spinal functions, too, since each rib is attached to a vertebra. Doctors sometimes see patients with one or more ribs only partially developed or with extra ribs. An extra rib may be attached to the lowest cervical vertebra, giving rise to a radiating pain in the shoulder and arm. The pain is due to the rib's interference with the functions of muscles and arteries in the area.

Although it is a fairly routine matter for an orthopedist to

study patients with certain ribs only partially developed, complete absence of a rib or ribs is rare. It occurs only in conjunction with vertebrae so malformed that the ribs have no place to which to attach themselves. Sometimes the ribs are present in the right place, but, by some irregularity before birth, they have taken unusual shapes. Forked ribs and ribs joined to one another are frequently seen.

Many congenital spinal defects may be present for years or, indeed, for life without their owners' being aware of anything wrong. Often anomalies are discovered only when X-ray pictures of the spine are made—for some entirely different reason from the search for the cause of an aching back. One doctor, who examined the spines of a thousand patients, none of whom came to him with back complaints, discovered that 44 per cent of these symptomless people had some type of anatomical variation in the back.

One of the common congenital spinal defects is known as *spina bifida occulta*. It may be unsuspected for many years. It is a malformation of the spine in which the vertebrae show a cleft, or failure to join. In many ways it is similar to cleft palate. Very early in embryonic growth (generally by the eleventh week), the two halves of the vertebrae join, as do the two halves of the palate. Sometimes the process is in some mysterious way interfered with and the juncture turns out to be either incomplete or inexact. *Spina bifida occulta* may occur in one or more adjacent vertebrae, and there may be much variation in the size and shape of the fissure. The upper three sacral segments are its most common site.

True *spina bifida* (as distinguished from *spina bifida occulta*) is much more severe, and, unlike *spina bifida occulta*, does not pass unnoticed, since it presents clear external evidence. In this

condition portions of the spinal cord and its covering membranes protrude, hernialike, from the cleft in the bones of the spine.

The most extreme, and most rarely seen, form of *spina bifida* is called *rachischisis*. This is a developmental condition in which a large section or all of the vertebral column may be split, and the spinal cord completely exposed.

The usual forms of *spina bifida* are frequently associated with other abnormalities. As was pointed out, such developmental defects occur early in the life of a fetus. At that time the spinal cord and the bony column are growing at the same rate, but a little later the column outgrows the cord, which appears to shrink upward. A defect in the bony parts may, therefore, hinder the cord in its apparent movement upward in the column and produce a number of symptoms in the cord and nerves. One condition frequently associated with *spina bifida occulta* is the growth of masses of fibrous and fatty tissues within the spinal canal. It is possible for such tissue deposits to interfere seriously with the functionings of the spinal nerves and, consequently, of the parts of the body they govern.

When symptoms of *spina bifida* or *spina bifida occulta* appear, they generally indicate that the condition has progressed to the point where it has wrought considerable damage to the spinal cord and nerves. Symptoms are most frequently manifest in the feet. A type of clubfoot, in which the arch is greatly exaggerated and the foot given a clawlike appearance, is the late symptom most often seen. Late in life, flaccid paralysis of the lower limbs sometimes occurs, and it indicates that the spinal cord has been seriously harmed.

Spina bifida and its resulting effects on the cord and nerves may lead to hyperesthesia (a condition in which the skin is ab-

normally sensitive to touch) or to anesthesia (in which there is little feeling of any kind). It may disturb the nutritional balance of the body as well as the ability of the blood vessels to contract and dilate. If perforating ulcers appear in the area where the defect occurs (and they often do), they, in turn, may lead to osteomyelitis of the underlying bone. Bladder incontinence is often seen, and violent, spastic contractions of the leg muscles may occur.

Other abnormalities of the bones are associated with *spina bifida*, too. Scoliosis, or spinal curvature, frequently appears. This is due to the fact that the affected vertebrae are likely to be asymmetrical—that is, half of the vertebra may be incompletely developed. This, naturally enough, leads to a curve in the direction of the better developed half.

Surgery is often successful in treating these cases of congenital defects and their resulting problems. The doctor nearly always suggests surgical treatment of *spina bifida occulta* when it appears that the symptoms are growing progressively worse, when digestive and circulatory symptoms are severe, and when the patient is unable to control his bladder. Sometimes operations are performed when muscle spasm, ulcers, or clubfoot are seen. Abnormal tissue deposits in *spina bifida* may be removed surgically, although the results cannot always be predicted with certainty.

As in almost all other cases, the best surgical results are obtained from early operations—as soon after birth as possible. The principle of surgery in the case of *spina bifida* is to unite the portions of vertebrae that Nature should have united during the prenatal existence. Bone bridges, for solidarity, are generally used.

CHAPTER VII

How Do You Stand with the World?

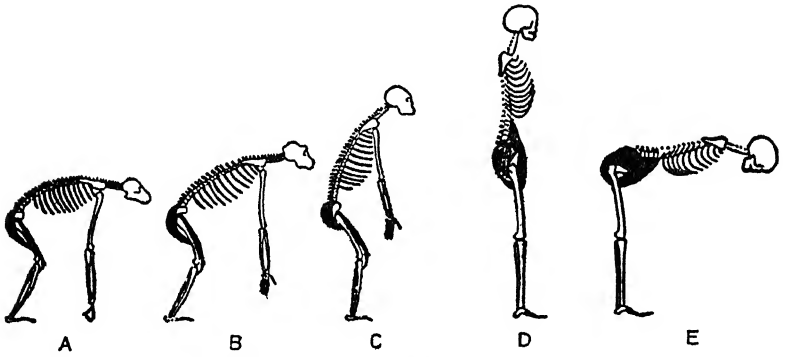
ONCE UPON A TIME man's ancestors walked on four legs—or, more accurately, on four hands. But in the processes of evolution he, alone among the primates (animals including man and the apes), developed feet and gradually pulled or pushed himself erect to walk on his two hind legs. Paralleling the development of upright posture, the size of his brain increased and, along with that, his power to think and concentrate. Since all the achievements of civilization are based on this power, man can thank his feet and the erect stance they have given him for a great many privileges and comforts he enjoys.

But that same erect stance also forces him to endure many pains and discomforts. It was not in the original design for man to stand erect, and his adoption of this means of moving about has led him into much misery. If he walked on four feet, all his internal organs would be suspended neatly from a horizontal spine. But when he chose to walk on two feet, he had to forego this pleasant arrangement in favor of a vertical spine and internal conditions under which all his organs tend, by sheer force of gravity, to droop earthward. A state of congestion consequently occurs unless he gives *conscious thought* to holding himself erect.

Four-footed animals do not have posture trouble.

Walking upright has given rise to other problems, too. The changes made in the spine by evolution have led to oddities in spinal structure. Four-footed animals have more or less straight

spines, and so did man's remote grandfathers. With erect posture came the necessary front-to-back curves of the spine—the cervical, thoracic, lumbar, and sacral curves. It often happens that the tilt of the pelvis, controlled by the same muscles of the back that control the position of the pelvis in relation to the



A, B, and C. Muscular shifts in the extension and straightening of the knees and thighs.

D and E. Development of anteroposterior curves in the erect position.

Functional disturbances attributable to the development of the erect posture. (*Redrawn from Baker, courtesy of* Archives of Physical Therapy)

thigh bones, causes variations in these curves and leads to postural strain and backache. The cervical curve, which supports the head, appeared late in evolution, and many persons experience pain because of faulty development in this area. These are only two of the many actual anatomic variations that may lead to postural and back troubles.

Doctors who advocate good posture don't hammer away at the subject just because they think people *look* better when they stand up tall—though, of course, they do. Carriage affects every organ in the body, and good posture helps muscles, bones,

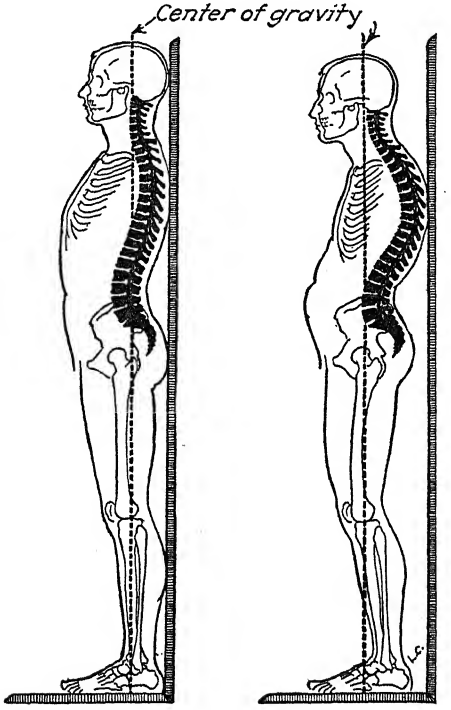
joints, ligaments, abdominal organs, and blood vessels. Eyes and brain will function with far greater efficiency than they can if the body is crumpled in a fatiguing, careless slouch. Poor posture compels the internal organs to crowd each other, and their natural tendency toward congestion is aggravated. Under these conditions they cannot perform their duties in anything like an ideally smooth manner. This chronic congestion is particularly hard on the reproductive organs of women, and the uterus, ovaries, and Fallopian tubes suffer especially. The digestive apparatus, too, is likely to complain loudly and act badly when it is crowded too much.

Bad posture has definite harmful effects on the muscular, as well as the bony and organic, structures. It stretches some muscles and ligaments and allows others to relax. Furthermore, the circulation of the blood is slowed down when posture is poor, and the decreased supply of blood reduces the nutrition and efficiency of body tissues. A sunken chest results in shallow breathing and, consequently, the supply of oxygen is insufficient for the body's needs.

But just what constitutes *good* posture? What does a person with good posture look like?

When a person with good posture is standing upright, it is possible to pass a plumb line from the top of his head and see it pass through his ear, his shoulder, the center of his hip, and his ankle. His thoracic and lumbar spinal curves are present but inconspicuous, his chest is erect (though not puffed out), and his feet and knees point straight ahead. His stomach neither sags nor is it "sucked in" exaggeratedly. His chin forms a right angle with the rest of his body. His shoulders are held comfortably straight, but they are not thrown back violently in a position impossible to hold for more than five minutes. If he is

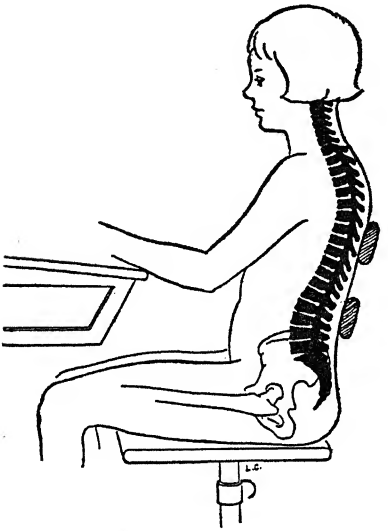
standing quietly, his weight rests solidly on his slightly separated feet, with the stress on his heels. If he is getting ready to move (and few of us stand perfectly still very long), his weight is shifted slightly to the balls of his feet.



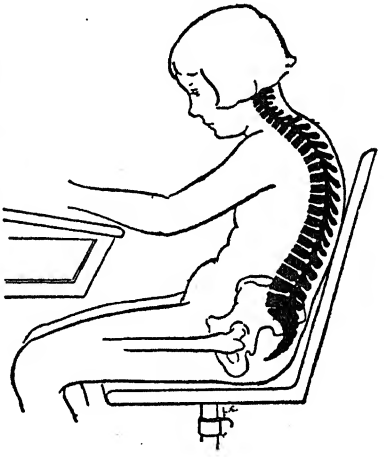
Skeletal form on the left shows good body posture; on the right, poor body posture. (*Lewin, courtesy of* Hygeia, *March,* 1935)

Now look at a man with bad posture: As he stands in what he considers an erect position, his pelvis and abdomen are thrust forward, his knees are bent and his chest is flattened. He is sway-backed and round-shouldered—and probably tired.

When he is sitting down, the man with good posture holds his head and trunk upright over his pelvis and bends his knees at right angles to his hips. But if he is sitting in an uncomfort-



Excellent sitting posture. (Bennett, Essentials in Hygienic Seating, courtesy of American Seating Company; Lewin, courtesy of Hygeia, *March,* 1935)



Illustrating skeletal deformity in poor sitting posture. Note the rounding of the thoracic spine and the flattening of the lumbar spine. (Bennett, Essentials in Hygienic Seating, courtesy of American Seating Company; Lewin, courtesy of Hygeia, *March,* 1935)

able, poorly designed chair, he won't be able to maintain this good position very long. The ideal chair is not the deep, soft, low armchair of the living room, which will make the relaxed sitter double up, but a straight dining-room type of chair. The seat is high enough so that it is not necessary to shorten the

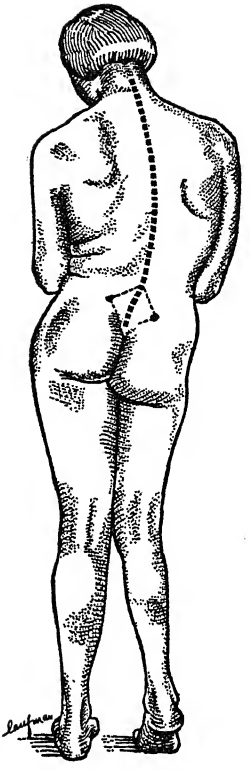
angle formed by the legs and thighs and not so high that the legs dangle. The seat is just as long as the sitter's thighs. The back of the chair is smooth and only slightly rounded.

And how about the man with poor posture? He is slumped in his chair, probably resting his weight as much on his lumbar curve as on his buttocks. His shoulders are rounded and his head protrudes forward in an ungainly manner.

Lying down, the good-postured man sticks to his fine habits. When he sleeps on his back, he may or may not use a pillow. His body lies at full length, and his feet and legs, relaxed, fall either outward or inward. When he lies on his stomach he doesn't use a pillow, since this would cause his neck to be stretched out uncomfortably; outside of that, his body position is the same as when he is on his back. Lying on his side, he uses a pillow in order to keep his head centered between his shoulders and prevent an extra curve from appearing in his neck. His hips and knees are usually flexed.

The poor-postured man does everything wrong and wakens in the morning feeling almost as tired as when he went to bed.

There are many widely varying causes of bad posture. Flat feet, sway-back, and unequal leg lengths may contribute to poor carriage and a chronically aching back. Infections, too, may cause a slumped stance. Fatigue, insufficient sleep, malnutrition, and mental distress cause the body to droop. Obesity, especially when the abdomen is prominent, has the effect of throwing the body off balance. The trunk must lean back and the lumbar curve must be exaggerated in order to keep the stout person from falling on his face. The same situation prevails in pregnancy, but here it is a temporary physiological measure. High heels cause the opposite effect—the body weight is thrown for-



This seventeen-year-old girl had infantile paralysis when she was two years old. Because of the flail right knee, with involvement of all groups of muscles, tendon transplantation was not possible, and a stiffening operation—arthrodesis—was performed. When she stood on both feet, there was a total right scoliosis; the right gluteal crease was 2 inches lower than the left; the dimple at the posterior superior iliac spine was lower on the right; the right iliac crest and anterior-superior spine were low; there were three folds in the left iliocostal angle and none in the right. When wood splints were placed under the right foot until it was raised 2 inches, the pelvis was level and the scoliosis corrected. (*Drawn from photo; Lewin, Infantile Paralysis, courtesy of W. B. Saunders Company. Note: A leg-shortening operation on the longer leg was advised.*)

ward by the raised heels, and in balancing the body the lower back must sway forward or the knees have to bend.

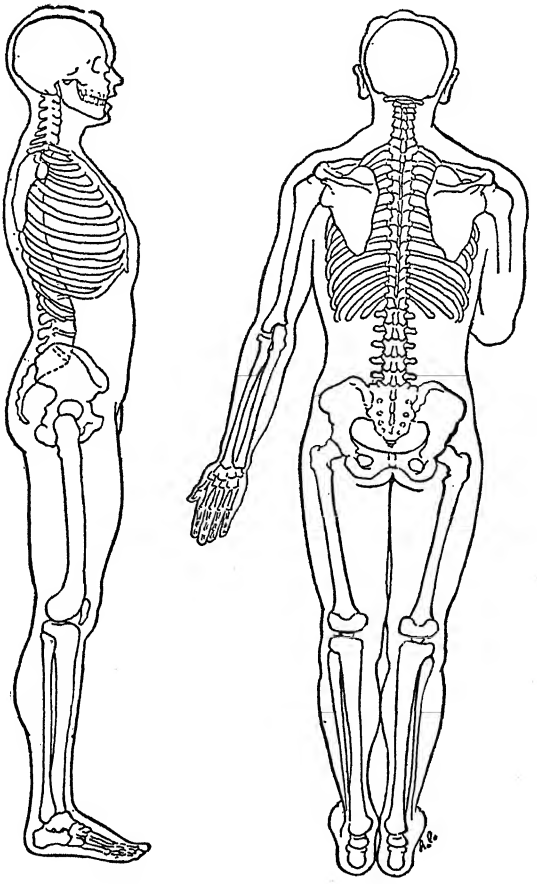
Surroundings at home, in school, and at work have a profound effect on one's carriage. Poor lighting is probably responsible for many aching backs, just as it is for nearsighted eyes. The wrong type of chair is a postural menace, especially to school children and to people who sit for long periods at their work. Even such seemingly unimportant things as poorly fitting, constricting clothes and shoes can and do affect posture.

Among children, the processes of growth often lead to faulty posture habits. Too rapid growth may cause slouching. Almost everyone is familiar with the sixteen-year-old boy who is 6 feet 2 inches tall and whose shoulders are rounded and knees bent in a constant effort not to look conspicuous. Excessive height at any age frequently results in stooped and rounded shoulders. The tall person finds too many occasions when it is necessary for him to bend over—going through doorways, sitting in low chairs, and so forth. Many girls, during puberty, become round-shouldered and stooped in a self-conscious attempt to hide their developing breasts. Very large breasts in older women may pull the shoulders forward.

The occupations of many people lead them into poor posture. Any vocation that calls for long hours over a bench or desk is a threat to good carriage. Bicyclists, musicians, and wrestlers are among the occupational groups subject to poor posture.

The effects on posture of anatomic errors in spinal structure have already been mentioned. Equally important are diseases or defects in other parts of the body. It is easy to understand how ear and eye defects, prolonged wearing of a cast on a fractured arm or leg, nerve injuries, diseases of the respiratory tract, or removal of one breast may also affect the way you carry your-

self. Muscle imbalance, too, can cause postural deviations. It is known that each muscle of the body has a companion muscle,



Two views of normal skeleton. (*Lewin, Backache and Sciatic Neuritis, courtesy of Lea & Febiger*)

which pulls in the opposite direction. If one of the pair becomes, for some reason, weaker than the other, the resulting imbalance

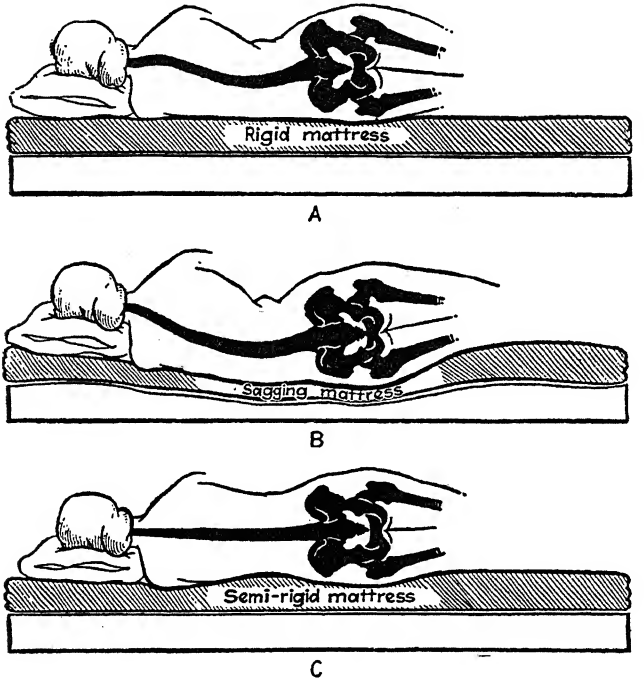
can throw the body out of its proper position. This is especially true of the back muscles. Rickets and other nutritional diseases may cause postural deformities like chicken breast or funnel chest.

Before the doctor decides that your backache is due to faulty posture, he finds out just how and where you are posturally out of line by recording your posture. He uses the camera, schematograph, and silhouettograph, and often he will take X rays to determine the position and shape of your bones and to discover any evidence of healed bone infections or fractures. Once he knows exactly where your problem lies, he can institute or formulate intelligent treatment.

Treatment depends, naturally, on the location and extent of your particular postural defects. In many cases, poor posture can be corrected by changing the type of shoe worn, by modifying the outside of the shoe (building up one heel, for instance), or by putting inserts into shoes. If the postural defect is due to fatigue, a good long rest may be enough to overcome it. Nutrition can be improved if poor diet appears to be a factor, and the doctor will urge correction of any outside influences—chairs, beds, lighting—that may be disturbing the posture.

Swimming, which exercises the trunk, arm, and leg muscles and induces relaxation, skipping rope, and dancing are often valuable in conquering faulty posture. Boxing is helpful when it isn't practiced too vigorously. Medical gymnastics are occasionally recommended to improve flexibility and coordination, power, breathing, and ability to relax, as well as posture. One exercise will show you the ideal position for walking: Stand with your back against a wall and flatten out the lumbar region —that is, try to touch the wall with the small of your back.

Then, holding your body erect, shift your weight forward to the balls of your feet and step off, keeping your body, mean-



A. Rigid mattress causes curvature of the spine when the patient lies on her side because of elevation of pelvic and shoulder girdles.

B. Sagging mattress causes curvature of spine because of improper support of the heaviest portion of the body.

C. Semi-rigid mattress supports all parts of the body properly. (*Lewin, Backache and Sciatic Neuritis, courtesy of Lea & Febiger*)

while, in the same position. Keep your head up, so that you are looking directly forward instead of upward.

If you are too relaxed, exercises to develop muscle tone and strength will be prescribed. If you are muscle bound, because of

short, strong muscles, you will be given stretching exercises, and if you are simply too tense, you will be taught to relax.

If your postural defect is really severe, the doctor may recommend that you use a semirigid mattress. Any mattress except the inner-spring type may be made semirigid by placing a board between mattress and bedspring. A completely rigid mattress is generally not advisable, for it forces the spine into an "S" curve when the sleeper lies on his side because the pelvic and shoulder bones are pushed up instead of being allowed to form little hollows for themselves in the mattress. A too-soft mattress causes curvature, too, since the heaviest part of the body, the pelvis, receives no support when the sleeper lies on his side. The body and the spinal column sag from shoulder to hip. One writer has called the inner-spring mattress "the devil's own work and a misbegotten gift of civilization." A really comfortable mattress is the semirigid type, which supports all parts of the body properly, keeps the spine straight, and allows the muscles to relax. Everyone would probably be better off if he slept on a felted-cotton or hair or sponge-rubber mattress regularly. After all, he spends a third of his time in bed, and it is unavoidable that his sleeping posture should have its effects on his daytime posture.

Support for the back may be necessary when the posture trouble is serious. An ordinary corset is the simplest type of support. It may be reinforced with a steel frame or with an aluminum cage. Many different types of braces have been developed, most of them of the harness type. Celluloid jackets and removable plaster-of-Paris casts are sometimes used, too.

In many cases physical therapy helps in treating postural defects. Massage, alternating hot and cold baths, and heat are helpful measures.

The most important—by far the most important—method of treatment, however, is *prevention.* Unless you have some actual deformity, you can do much more to promote and maintain your own good posture, and that of your children, than your doctor can.

Postural habits have their beginnings in childhood—indeed, in infancy, although an infant's posture bears little resemblance to that of an adult. His spine has only one real curve—a long, convex arch from head to hip. As he begins to lift up his head, however, the cervical curve appears, and as he straightens his legs in his attempts to walk, the lumbar, low-back curve takes form. While the infant is learning to stand up, special care should be taken to see that he stands on a hard, flat surface (not a soft mattress) and that his shoes, though not stiff, have strong soles. This will help him keep his feet planted solidly and will allow his arches to develop, since a baby has no visible bony arch in his feet. A flat, firm bed is best for the baby, and the chair he uses should fit his back and legs.

As a child grows, he becomes more and more active, using an increasing number of muscles and attaining, during the early years, good posture, which is a valuable asset. The games he plays teach him balance and coordination, and he is not hampered by the conventionality of movement that will affect his bearing as he grows older. You, as a parent, can help your child retain his early good posture by seeing to it that he has every advantage that such postural factors as adequate lighting, good chairs, correct beds, proper nutrition, and prompt treatment of eye and ear defects can give. It is up to you to give him the best possible start toward healthy adult posture.

The following rules for good posture have been compiled

after many years of observing the requirements of good posture and the sometimes devastating effects of bad posture.

Ten Commandments of Good Posture

1. Stand tall; sit tall; lie tall and flat.
2. Walk tall and chesty.
3. Draw in your abdomen, pulling it backward and upward.
4. Flatten the hollow of your back.
5. Roll your pelvis downward and backward and lock your buttocks; lock your legs together; streamline your hips.
6. Keep your shoulders high and square; separate them as far as possible from your hips.
7. Hold your head high, chin up and back, eyes straight ahead, as though you were balancing a basket of fruit on your head.
8. Walk with graceful heel-to-toe rhythm.
9. Take the arch out of your back and put it in your foot.
10. Become posture conscious

The tenth is probably the greatest of these commandments. If you follow it, you're almost sure to be following the others at the same time. If your tendency is toward careless posture—and whose isn't?—you should constantly give yourself this good advice: "Stand tall, sit tall, lie tall," and, above all, "*think* tall."

CHAPTER VIII

Bacterial Infections of the Spine

IN THEORY, any bacterial disease may attack the spine if it can find its way into the blood stream from the originally infected source, such as teeth, tonsils, sinuses, lungs, prostate or seminal vesicles. In practice, there are only two infectious diseases that are important in a study of the back. They are tuberculosis and osteomyelitis of the vertebrae. Two far less important diseases, brucellosis and actinomycosis, will be discussed briefly here, but the two aforementioned deserve the most attention. Both are extremely serious and may result in years of disability when they are not fatal. Both are primarily diseases of children and adolescents. Treatment of both involves long, hard labor on the part of the doctor and his patient.

TUBERCULOSIS OF THE VERTEBRAE

Vertebral tuberculosis, or Pott's disease, as it is often called, makes its appearance in early childhood, adolescence, or, more rarely, early adult life. The tubercle bacilli invade the vertebrae by way of the blood from such structures as the lymph nodes, where they have made their first stand.

One of the most prominent symptoms of Pott's disease is limitation of movement of the spine. The child who has the disease has difficulty in bending his back and tends to extend it, rather, in order to relieve the discomfort. The normal incurving of the lumbar and cervical regions is diminished. The muscles

of the back contract involuntarily in a spasm conveniently provided by nature to protect the diseased area by rendering it motionless. Pain is present. It may be either localized at the site of the infection or referred through the nerve channels to other parts of the back. Children with vertebral tuberculosis will often cry out in pain during sleep, because in sleep the protectively contracted muscles relax and any stirring about causes nerve irritation and subsequent pain. The posture of the child is affected, since he adopts positions that give him the least amount of pain. If the inflammation is located in the vertebrae of the neck, he often lifts his chin in his hands, as though to support his head and neck. An exaggerated military carriage may be seen when the disease has attacked the thoracic vertebrae. Often the child will walk on tiptoe, as though to avoid jarring his spine. A feeling of general discomfort and weakness and a rise in temperature during the afternoon is also characteristic. Examinations of the blood and X rays of the back, combined with a study of the symptoms, help the doctor to diagnose vertebral tuberculosis.

What the tubercle bacilli actually do, or attempt to do, is destroy the vertebrae they infect. They accomplish this in one of two ways. They may cause the bony and soft tissue parts of the vertebrae to change into a cheesy substance (caseation), or they may cause sclerosis (hardening) of the bone. In the latter, the bone tissue is replaced with hard connective tissue, due not to the bacilli directly but to the fact that the bacilli have disturbed the blood supply in the area to such an extent that the bones no longer receive the nourishment necessary to life.

The early formation of abscesses, or areas of pus infection, in most cases of Pott's disease, has an important bearing on the course of the disease. Pus secretions from an abscess are particularly effective against the intervertebral disks (the cushions be-

tween vertebral bodies) and can destroy them within a brief time. Loss of the disks causes adjoining vertebral bodies to collapse against each other. The weight carried by the back, instead of being shared by the vertebral bodies and their projecting arms, then rests solely on the disease-eroded bodies. Since the body is the part of the vertebra nearest the front (that is, toward the chest and abdomen), the afflicted child's tendency to hold himself with exaggerated erectness is easily understood. Any forward bending of the spine causes increased pressure on the infected vertebral bodies and results in pain, while extension of the spine relieves them of weight and, consequently, of pain.

The collapse of the vertebral bodies often causes the bony processes or arms of the vertebrae to be pushed unnaturally outward. A conspicuous bump known as a *kyphos* appears in the spinal column at the site of the infection.

In treating a case of Pott's disease, the doctor aims at several well-defined objects. He wants first to arrest the disease and to prevent it from making further inroads on his patient's spine. He tries to prevent deformity or, if too late for that, to repair the damage already done. Since the best possible general physical health is always important, he builds his patient up as much as he can. If an abscess has appeared, he relieves it. He wants especially to get his patient out of bed and back to normal life at the earliest possible date. If the patient is a child, the doctor hopes for, and aims at, continued growth of the vertebrae after the disease has been arrested. He tries to maintain the sick person's morale at the highest possible level, because he realizes the effect it may have on treatment.

And how does he go about attaining these aims?

The cure of vertebral tuberculosis in children depends principally on long-continued rest without weight bearing. Rest in

this case means rest of the whole body and, in particular, of the back and the area of the back where the disease has penetrated. It is necessary, in order to insure complete rest, to immobilize the patient and his diseased back in a plaster bed. This may be necessary for several years. The plaster bed keeps the back motionless by splinting it externally. Internal immobilization is accomplished by operative fusion of the diseased vertebrae, which renders them more quickly permanently immobile.

If centers of living bone remain in the diseased vertebrae, fusion will often occur spontaneously; that is, if the doctor can arrest the progress of the disease, the damaged vertebrae will, of themselves, grow together and accomplish self-immobilization. This, however, is a long process, taking, on the average, six years for its completion. If it appears that spontaneous fusion will not take place, surgical fusion is possible and frequently successful. The fusion operation procedure described in Chapter IV is employed.

Many doctors frown upon surgery for Pott's disease except in cases where conditions are especially favorable. In any case, it is not wise to operate when the patient is run down or otherwise in poor health. If tuberculosis is present in other organs of the body—the lungs being the most common site—surgery is generally not advisable, at least until the disease has been brought under control. The presence of abscesses increases surgical risk, too, because of the danger of contamination of the surgical wound with pus from the abscess. Fusion, under whatever circumstances, is a means to an end, the end being the complete healing of the area and the routing of the bacilli.

After either surgical or spontaneous fusion, the sick child must remain in his plaster bed for several months before he is allowed gradually to move about, supported by a celluloid

jacket or brace. Protection of the spine is necessary for at least a year after operation.

Operation may be performed in many cases for the relief of abscess. The doctor will probably resort to surgery when an abscess is extremely large, when there is danger that it may rupture and, consequently, produce a secondary infection, when secondary infection is already present, when there is pain, when the abscess, because of its location, interferes with mechanical treatment, when it is spreading rapidly and undermining tissues, or when it exerts pressure on nerves. To treat an abscess, the surgeon punctures it and allows it to drain, a procedure that generally must be repeated many times. Sometimes he injects one of a number of possible solutions to promote drainage and healing.

When a kyphos has developed, the surgeon may reduce it by gentle and gradual manipulation in the course of other treatment. Heliotherapy, or treatment with ultraviolet rays, is valuable because of its general tonic effect.

One of the severe and most feared complications of Pott's disease is paraplegia, or paralysis of the body below the waist. It is due to the effects of the disease on the spinal cord and on the nerve roots in the diseased area and most often appears in conjunction with an abscess. Paraplegia may be cured in most cases—in children by conservative treatment and in adults by operation. Extension of the spine is often successful with paraplegia in children. Laminectomy, combined with grafting, aids in conquering it in adults by immobilizing the spine, thus protecting the column from further erosion and promoting healing.

Any treatment of spinal tuberculosis is more than merely a treatment of the back, since tuberculosis is a general disease and its attack on the back is only a skirmish in the over-all campaign.

Tuberculosis may be present in other organs and is always in the blood stream. It would be perfectly possible to cure the patient's spine and still leave him with active tuberculosis if attention were not paid to the general disease as well as to its incidental local appearance.

Generally speaking, it may be said that tuberculosis of the spine is cured when symptoms disappear, when there is evidence that new bone growth has taken place, and when the patient begins to undertake normal physical activity. Much hope can be held out to the person who has vertebral tuberculosis, and although cure involves years of patient and laborious treatment, it can be effected.

Osteomyelitis of the Vertebrae

Osteomyelitis is an extremely serious disease which is difficult to diagnose and which has a high mortality, due in part to the complications that can accompany it. It has both acute (sudden) and chronic (long lasting) forms. Early diagnosis and treatment are of vital importance, because early operation is effective and delayed treatment often of little use.

Vertebral osteomyelitis, although seen in adults, predominates in the second ten years of life and is most common in children between twelve and sixteen years of age. Osteomyelitis, like tuberculosis and other infections, may enter the body through many routes. In one case, a boil resulted in osteomyelitis of the thigh bone; from the thigh the infection spread through the blood stream to the spine. In another case, the disease began with a splinter in the leg. Also like tuberculosis, osteomyelitis is primarily a disease of the blood stream, and its appearance in the vertebrae is only secondary to the general infection.

Vertebral osteomyelitis appears suddenly, with pain and tenderness in the involved vertebra (the disease most often attacks only one), swelling, chills, and fever, often very high. The area attacked is rigid, since the disease limits the movements of the intervertebral joints and irritates the spinal ligaments. Any movement of the spine increases the pain. The symptoms are due to the abscess that forms in the area rather than to the actual bone lesion. Several days or weeks may pass before evidence of bone deterioration shows up in X-ray pictures, so X rays are of little aid in early diagnosis.

In its early stages, osteomyelitis of the spine is easily confused with rheumatic fever, acute arthritis, meningitis, typhoid fever, peritonitis, appendicitis, pleurisy, or pneumonia, and consequently the doctor must depend on the local signs—pain on pressure, swelling, and so forth—in diagnosis. Examination of the blood reveals large numbers of white-cell shock troops, mobilized to combat the infection.

Osteomyelitis can be treated with drugs, including the sulfonamides and penicillin, and repeated blood transfusions are often necessary. Operation (for the purpose of draining the abscess) is the most important method of treatment. Also through surgery enough diseased bone may be removed to bring the infection under control. In doing this, however, care must be exercised not to remove so much bone that the function of the spinal column is jeopardized.

Osteomyelitis is often fatal, especially when it has been allowed to progress into the spinal cord. Since it is so hard to diagnose, the infection sometimes gets beyond control before it is recognized. A certain amount of deformity is frequently present in cured patients, the amount depending on how much bone tissue was destroyed by the infection.

Brucellosis of the Vertebrae

Brucellosis, often called undulant fever or Malta fever, is a fairly widespread disease, which has been recognized only recently. It has both chronic and acute forms and is transmitted to human beings from infected cattle primarily through milk, cream, and other fresh dairy products. Less commonly, the disease is transmitted through contact with infected animals, with freshly killed meat from infected animals, or with live cultures during scientific work. Infection of the vertebrae is the complication of the general infection most often seen. It usually appears when the patient is convalescing from general brucellosis.

Minor symptoms of fatigue, weakness, loss of appetite, constipation, headache, backache, cough, muscular pain, restlessness, and insomnia are usually seen in brucellosis. Muscle infection frequently occurs, with resulting pain in the muscles involved. The disease cannot be diagnosed specifically unless the laboratory is able to find the responsible organism (*Brucella melitensis*) in the blood.

Undulant fever is a disease that, at least in the vertebrae, usually cures itself. It appears that repair goes on even while the disease is in progress. Artificial fever therapy is frequently effective in banishing the Brucella organism.

Real control of brucellosis must begin with the infected animals that transmit the disease to men. Slaughter or segregation of diseased cattle and immunization of calves help to reduce the danger of infection, and care used in handling the animals and their products, including proper pasteurization of milk, prevents the spread of the disease among men.

Actinomycosis of the Vertebrae

This disease, caused by infection with a ray fungus (a mold that spreads out like the spokes of a wheel), is a malignant condition often overlooked because of its resemblance to tuberculosis. It is another of the infections transmitted to man from animals. In cattle or horses, actinomycosis appears in a form called "lumpy jaw." If any kind of open wound in a person's skin, such as a scratch, comes in contact with the fungus, the disease may be contracted. Treating infected cattle is the most common way of acquiring actinomycosis, but patients with tooth decay and pyorrhea have developed it after chewing grass or straw harboring the fungus.

The symptoms are vague (backache, tenderness, and limitation of movement) and may be characteristic of any number of infections. The actinomycetes (ray fungi) are often hard to locate in the blood or pus, but they can usually be identified if some of the infected tissue is removed and examined microscopically. Specific diagnosis cannot be made until their presence is demonstrated.

Actinomycosis is often fatal, particularly if it is allowed to progress very far before diagnosis is made and treatment instituted. The only real treatment is chemotherapy plus the surgical removal of all the tissue involved.

CHAPTER IX

Disorders of the Nervous System

AT VARIOUS PLACES so far the anatomy of the nervous system has been mentioned, but a brief review of its more important points will be helpful. While many phases of neurological development are too complicated for general discussion, the basic elements are easily grasped and are vital to an understanding of the diseases or injuries that, by damaging the cord or nerves, have harmful effects on other parts of the body, including the back.

Reviewing, then, you remember that the spinal cord begins at the *medulla oblongata* (the lowest segment of the brain) and ends in the *conus medullaris* at the lower level of the first lumbar vertebra. The *dural sac* is a continuation of the cord proper, which extends from the lowest limit of the cord down to the lower border of the second sacral vertebra. The cord ends in the *cauda equina,* which means, literally, tail. The cord and sac contain cerebrospinal fluid; the fluid maintains pressure in the cord, which can be measured and likened to blood pressure. The cord is wrapped in three layers of coverings known collectively as *meninges* and individually as the *pia, arachnoid,* and *dura mater.* They serve as protection for the cord, much as skin and fat layers protect the internal organs.

Spinal nerves are attached to both the dorsal (toward the back) and ventral (toward the abdomen) sides of the cord. The nerves join the cord by means of their roots, which look exactly like their names; they are frayed-out bundles of nerve fibers and

are called dorsal or ventral, depending on the side of the cord to which they are attached. Each nerve has both dorsal and ventral roots. Though the roots pierce the spinal covering separately, they are enclosed in a single sheath of dura. From their bases in the spinal cord, the nerves pass through the openings (*foramina*) in and between the vertebrae out through the body to the arms, legs, chest, and abdomen.

In discussing pain, the doctor often mentions "localized" or "referred" pain. The difference between them is that localized pain is intensified by local pressure, while referred pain may be relieved by pressure. In the latter, pain is felt in a neighboring area of greater sensitivity rather than in the area of lower sensitivity to which the painful stimulus (in this case, pressure) is applied.

Essential to the diagnosis of disorders of the nervous system is a neurological examination. This includes detailed study of the reflexes, muscular strength and tone, sharpness of the senses, gait, coordination, and balance. Studies of the cerebrospinal fluid, drawn out by puncture of the spinal canal in the lumbar area, are also often helpful.

Everyone is familiar with the test of the patellar reflex, in which the physician taps the patient's knee with a rubber hammer to see if the expected kick appears. Presence of the involuntary kicking motion indicates that the reflex arc from the knee to the spinal roots is complete and uninterrupted. There are other "deep" reflexes—the biceps, on the front of the arm just above the elbow, and the triceps, in a similar position on the back of the arm; the anterior tibial, on the shin; the radial, on the forearm; the hamstrings, behind the knee; the Achilles' tendon, just above the heel; and the scapulohumeral, on the

shoulder blade. There are also "superficial" reflexes that may be studied in diagnosis. Observations of a patient's muscle power and manner of walking tell the doctor a great deal about how well his muscles function.

In testing sensory function, the doctor determines reactions to heat and cold, sharpness and dullness, and touch. Touch tests vary from stroking the skin with cotton to pinching. Alternate applications of the head and point of a pin tests sharpness and dullness reactions, and touching the skin with test tubes containing first warm and then cold water indicates to what extent the patient can distinguish between heat and cold.

An interesting nervous phenomenon, present in everyone to a greater or lesser degree, is known as *stereognosis*. This is the ability to correlate and interpret varying sensory impressions, and it makes it possible for a person to put his hand in his pocket and recognize various coins, keys, and so forth, by touch. Stereognosis enables the blind newsboy to make change quickly and accurately.

Many valuable diagnostic neurological tests may be employed to determine the presence of a specific disease, but no one test is indicative of any specific disease. Brudzinski's neck sign is positive only in the case of irritation of the meninges; or if passive forward bending of the patient's neck causes his thigh to flex on his abdomen, he is suffering from meningeal irritation. Reactions of the muscles to electric currents are indicative of the presence or absence of nerve degeneration. Normal muscles react by contracting when the electric current is flowing through nerve and muscle, and nerve function is known to be impaired if the muscles fail to contract when current is applied.

Spinal fluid for study is obtained by spinal puncture. The patient lies on his right side with his back bent, and the fluid is

extracted in much the same manner as blood is extracted from a vein. The cord, however, is much harder to reach and correspondingly greater care and skill in drawing off the fluid are necessary. The fluid is examined for its physical, chemical, histologic, biologic and bacteriologic properties. Color, clarity (normally it is as clear as water), and pressure of flow are studied. Presence of blood and sugar and the albumin level are significant. Spinal puncture is sometimes performed so that therapeutic drugs may be injected. When a drug is to be injected, an equal amount of fluid must be allowed to escape, so that normal pressure will not be disturbed.

Measuring the pressure of the spinal fluid is especially important when a growth or tumor in the cord is suspected. Any such obstruction interferes with the circulation of the fluid, and the altered circulation is revealed by tests of the pressure.

Before the discussion is continued on diseases of the nervous system that result in back pain, definitions must be given of three terms that are as much abused as any in the whole field of medicine.

Neuritis means *inflammation* of a nerve. That's all. It is a condition seldom seen as a pure disorder.

Neuralgia means *pain* in a nerve or along the area traveled by the nerve. There is no evidence to indicate inflammation, and the power of the nerve to conduct impulses, move muscles, or cause sensation is not affected.

Sciatica is a symptom, or, rather, a combination of symptoms, indicating that some abnormal condition along the course of the sciatic nerve is disturbing it.

Sciatica

The sciatic nerve is the largest and longest in the body. Its roots are in the lower lumbar and sacral vertebrae. From these roots it passes through the pelvis and down over the leg and is finally distributed in the skin of the leg and the muscles of the thigh, leg, and foot. Along this intricate and extensive course there are innumerable opportunities for irritation of, or pressure on, the nerve because of inflammation, tumors, and other lesions in the bones and tissues surrounding it. The resulting frequency of sciatic pain is not surprising.

Congenital anomalies, vertebral arthritis, defective posture, and disorders of the metabolism, circulation, or glands of internal secretion most often cause the irritation that produces sciatic pain. Infection, injury, exposure to cold or dampness, fatigue, and vitamin deficiency are frequent precipitating factors. Flat feet can aggravate the pain by adding an irritating mechanical factor to the already disturbed nerve. Many people with sciatic pain are shown to have disorders of the nerves in the lumbosacral region—particularly pressure on the fifth lumbar nerve root, which is a very large root with a very small, bony channel through which to pass. Rupture of an intervertebral disk is sometimes responsible, too.

If you've never had an attack of sciatic pain, here's the way you may recognize it: It usually begins as "lumbago," or pain in the low back. After days or weeks have passed, it appears again—this time in the hip, thigh, leg, or ankle, depending on where the nerve is being irritated or compressed. Sometimes the pain begins in the leg and there is little or none in the back. It may be either constant or spasmodic and it is often made worse

by movements like rising from a chair or getting out of bed, coughing, sneezing, or straining at stool. The intensity of the pain varies widely, but there are generally periods of exceptionally acute agony. During and shortly after the periods of acute pain, the body will be bent sideways.

The oldsters who say they can tell when a storm is brewing because their sciatica gets worse aren't exaggerating. They really can, because symptoms are usually worse before a storm. Cold wind and dampness are hard on the sciatic patient, and warm weather, either wet or dry, often gives him relief.

In diagnosing sciatic pain (which really means a hunt for the cause), the doctor will consider the type and location of the pain. But pain is such a subjective complaint that it must be substantiated by more objective evidence. This is provided by, first, a physical examination to discover the points of tenderness, the bulk, strength, and contour of the muscles, the activity of the reflexes, and the condition of sensory perception. Then X-ray examination is important, for the doctor can tell almost as much from what isn't on the photographic films as he can from what is there, since the absence of certain signs automatically eliminates certain conditions from his list of possibilities. X-ray pictures are generally taken of the back from the tenth thoracic vertebra down through the hips. What the X rays most often show are congenital defects of the spine or changes in the normal anatomy due to arthritis or injury, any of them leading to pressure on the sciatic nerve. Also, rectal and vaginal examinations are helpful. By rectal examination, the doctor can feel the nerve and the sacroiliac joint and, in men, discover any disturbance in the prostate. Prostatic cancer is one of the causes of sciatic pain in men over fifty.

Rest, support, and physical therapy—those stand-bys in so

many spinal disorders—are important factors in treatment. Strapping the pelvis often relieves sciatic pain in mild cases. Manipulation, too, offers hope for relief, as does the injection of anesthetic drugs. Of course, any focal infection or disease is treated, and the doctor aims at the correction of faulty posture. Posture is of prime importance, and a spinal brace is often recommended. A person suffering from sciatic pain should sleep on his back on a semirigid mattress with no pillow. Some patients prefer to lie face downward with their feet hanging over the end of the mattress.

Injection of vitamin B_1 has been found beneficial in many cases. Diathermy, light massage, different types of baths, and heat on the affected part have their places in relieving the pain of sciatica.

Surgery is sometimes resorted to, but the types of operation vary so greatly, depending on the nature of the condition, its cause, and the specific area of irritation or compression, as well as on the preference of the surgeon, that it is impossible to describe all of them here. However, whatever the operation, it is performed to relieve the pain and to eliminate its cause.

Unfortunately, it is impossible to say exactly what the outcome of any treatment will be. Sciatic pain is a much too complicated disorder for exact results to be predicted. Even after the condition is considered cured, some small disorder may remain and result in later attacks of pain. The patient can help himself a great deal by maintaining proper posture and by avoiding injury, infection, metabolic disturbance, and exposure to extreme cold or dampness.

Less Frequent Nerve and Cord Disorders and Injuries

Concussion, contusion, rupture, and cutting of the spinal cord may occur through injury. Concussion (in which function is impaired because of shock) occurs often because of transmission of a blow on the spine to the cord, even though the cord appears to be suspended free of the actual bony parts of the spine. Though great injury can be inflicted to the vertebrae without affecting the cord, the danger of later outbreaks of trouble in the cord or nerve roots is always present. In all cases where there is pressure on the cord, it is necessary to correct the condition early—delay means the difference between success and failure.

When the spinal cord has been completely severed, the injured person feels as if he were suddenly cut in two at the point of injury. Though even the greatest injury to the cord does not cause cord pain (it has no sensory nerve endings), pain will be present because neighboring nerve roots are also injured. Severance of the cord causes complete loss of movement and of feeling below the level of the injury; the reflexes are absent, the muscles flaccid, and the skin dry and cold. The injured person loses control of his bowels and bladder. If any sensation is preserved in the body below the injury, it is an indication that the cord has been only partially cut.

The most important factor in treating severe spinal cord injuries is prompt attention. The injured person should be moved to the hospital, and those carrying him should be very careful not to cause further injury to the cord and nerves. If a stretcher is not available, a board, shutter, or door is the best object on which to carry the patient. He should be lifted face down by three or four persons, and his body should be kept straight.

When cord injury appears along with fracture of a vertebra, treatment is long and complicated and sometimes not very rewarding. Some permanent disability often remains.

The greatest danger to life faced by a person with a severely injured spinal cord lies in the urinary tract infections, which are so likely to follow in the wake of long paralysis of the bladder. The paralyzed person's bladder must always be carefully watched and attendants must make sure that it is frequently and properly emptied. The treatment should be directed by a urologist.

Myelitis, or inflammation of the coverings of the spinal cord, is another serious condition of the cord. Adhesive arachnoiditis, an inflammation of the arachnoid membrane, one of the inner coverings of the cord, sometimes follows acute meningitis. Syringomyelia is a chronic disease of the cord characterized by absence of pain and loss of the sense of temperature but retention of the sense of touch, progressive wasting away of the muscles, and paralysis. The muscular atrophy is seen most frequently in the arms and hands.

Multiple sclerosis is a chronic disease in which patches of connective tissue appear in the central nervous system. It is generally fatal, though its progress is often halted for long periods of time and a few cases of recovery have been reported.

Radiculitis is the term used to identify irritation of the spinal nerve roots. Pain, aching, and soreness are increased by movements of the vertebrae when the sick person sneezes, strains at stool, coughs, raises his head, gets out of bed, rises from a chair, sits in one place for a long time, or lifts anything heavy. The area of discomfort depends on where the lesion is located. If nerve roots beginning in the cervical region are responsible, there will be headache and sore neck, shoulders, and arms.

Heart, or apparent heart pain, appears when the upper thoracic area is responsible. There is discomfort in the gall bladder when the middle thoracic vertebrae are involved and in the lower abdomen (similar to appendicitis pains) when the lower thoracic vertebrae are to blame. Pain in the hips, thighs, or legs appears when the lumbar vertebrae are inflamed.

Coughing, sneezing, heavy lifting, and straining all cause pain when the nerve roots are out of order. This is due to a sudden increase in spinal pressure and the distention of blood vessels in the area of the roots. Root pain is also likely to increase at night, during sleep—probably because the spinal column is stretched out when a person is lying down. Getting up and walking around oftentimes relieves this kind of pain.

Rest in bed on a hard mattress, head and pelvic traction, physical therapy, elimination of focal infections, medication (including vitamin B_1), injections, and occasionally surgery, are methods of treatment followed in nerve-root disorders.

Poliomyelitis

Of all the many diseases of spinal cord and nerves—and most of them threaten and are capable of serious and lasting consequences—the one that causes greatest fear and horror is poliomyelitis, or infantile paralysis. Probably the terror the threat of a polio epidemic always brings on is due largely to the fact that the disease, though it may attack adults, is primarily one of childhood. The panic is felt by parents of young children, who are prone to be nervous about their children's health anyway. The fact that polio may leave a child permanently crippled seems to frighten parents even more than the thought of death as a result of it. Since the summer of 1916, when 27,000 per-

sons, mostly children, suffered and 6,000 died from polio, the disease has been a grim specter to parents.

The really important factor in curbing the depredations of polio is, as in the case of all communicable diseases, prevention of its spread. Unfortunately, that is exactly what science is as yet unable to do, because science does not know *how* it is spread. There have been many theories expressed and given trial but none of them has ever been proved satisfactorily. Panic-stricken communities have tried everything from quarantine to spraying DDT during polio epidemics and none except possibly one has been able to prove that the measures in any way altered the course of the epidemic. It is known that poliomyelitis appears as a result of invasion of the body by a virus. Intensive research is being conducted to find out how the virus is spread, how it is nurtured, and how it is killed. There is little doubt that all these questions will be answered within the next few years.

Meanwhile, what is polio like?

There are a number of symptoms common to innumerable childhood diseases. The most frequently seen are a general feeling of sickness, moderate fever, head cold, sore throat, bowel upset, vomiting, fretfulness, and restlessness. When those symptoms appear in the summer, during the polio season, they should be taken more seriously than at other times because, while not specifically polio symptoms, they indicate some illness that might turn out to be polio. Parents should watch the child carefully for development of an expression of impending disaster, apprehension, acute illness, prostration, headache and backache, sore or tender muscles, fever of 102 to 104 degrees, tremors, stiff neck and back, pain when the head is bent forward, or changes in the reflex actions. If these appear, polio may be suspected and the child should be under a doctor's care.

The doctor can confirm the presence or absence of infantile paralysis. If the spinal fluid is altered, or if muscle weakness or paralysis develops, he can make a positive diagnosis of polio.

In treating poliomyelitis medically, human convalescent serum is an important measure, both before and after paralysis has appeared. No matter what the condition of the muscles, convalescent serum should be given to children whose fevers remain high. When the disease has attacked the cervical region of the spinal cord and thus paralyzed the muscles of breathing, the respirator is of great value.

A most important method of treating polio at the present time is physical therapy, and of the various types, the system developed by Sister Kenny appears to be effective in minimizing deformities and disabilities of the child's back, abdomen, neck, pelvis, and legs.

Miss Kenny believes that pain, muscle spasm (a condition in which a muscle is tense, firm, taut, prominent, tender, and painful when stretched), mental "alienation" (a physiologic, but not organic, interruption in the course of a nerve from its root to the muscle it controls), and muscle incoordination (in which one muscle moves when another is supposed to) are the evil elements in polio. Her treatment aims at eliminating pain and muscle spasm, and to this end she uses hot packs and proper rest positions. The hot, wet packs applied to muscles in spasm are strips of woolen cloth that have been soaked in boiling water and wrung out. Properly used, they stay hot for about fifteen minutes, gradually cooling to lower temperatures, a process that is good for both muscles and nerves. Muscle reeducation follows this immediate treatment. Through analysis and training of the affected muscles, it is intended to restore coordination and to substitute mental awareness for alienation. For best results,

Miss Kenny's method should be applied immediately after the diagnosis is made.

Spasm in the muscles of breathing, which causes labored respiration, may be relieved by hot packs. In some cases, artificial feeding, splints, suction apparatus, and respirators are required. The respirator helps the patient to breathe artificially but does not teach him to do it for himself. In this event, he must be *taught* to breathe properly.

Proper bed posture is an important matter. The child should have a rigid bed with a small pad beneath his knees and with a footboard against which his feet can be placed so that his standing muscles will function and he will retain his feeling of contact with the floor. He should be turned over on his abdomen for an hour twice each day, with his feet hanging clear of the edge of the bed. After his muscles have begun to coordinate properly, he should be allowed to move about in bed.

Polio wards are kept very warm—so warm that the heat is hard on the nurses and physical therapists who work with the children. Through the Kenny method of minimizing pain and spasm and preventing muscle contractures and gross deformities, disability is lessened and, correspondingly, the harmful effects of the disease are reduced.

There are other physical therapy measures used by orthopedic surgeons in treating poliomyelitis. Underwater gymnastics are frequently helpful. The best method is to suspend the patient with rings, pulleys, and so forth in a tank filled with warm water. If the water is shallow and the apparatus reassuring, the helpless child will not be afraid of drowning. Muscle exercises are then performed under water.

Massage, while helpful, must be done by a skillful person under a doctor's direction; otherwise it can be very harmful.

One of the most important functions of massage is to increase circulation in paralyzed muscles, where it is apt to be poor. Hot packs or an infrared lamp, used just before massage, make it even more effective. When massage is being given, the patient should be made comfortable so that he can relax. Massage should never cause pain or be prolonged enough to tire the sick child. Actually, massage has much the same effect as exercise, and too much massage is just as fatiguing as too much exercise.

On recovery from the acute phase of the disease, the child must be retaught how to walk. Parallel bars, where he may balance himself as he is taught first to stand and then to walk, are used before he turns to crutches or canes.

One of the tragic aftereffects of poliomyelitis may be scoliosis, or spinal curvature. Surgery—either spinal fusion, resection of ribs, or operation on the abdominal wall—will correct this in many cases. Distortion of the pelvis, either toward the side (in which scoliosis results) or toward the abdomen (with resulting lordosis), is another possible aftereffect that may also be helped by surgery.

CHAPTER X

The Injured Back

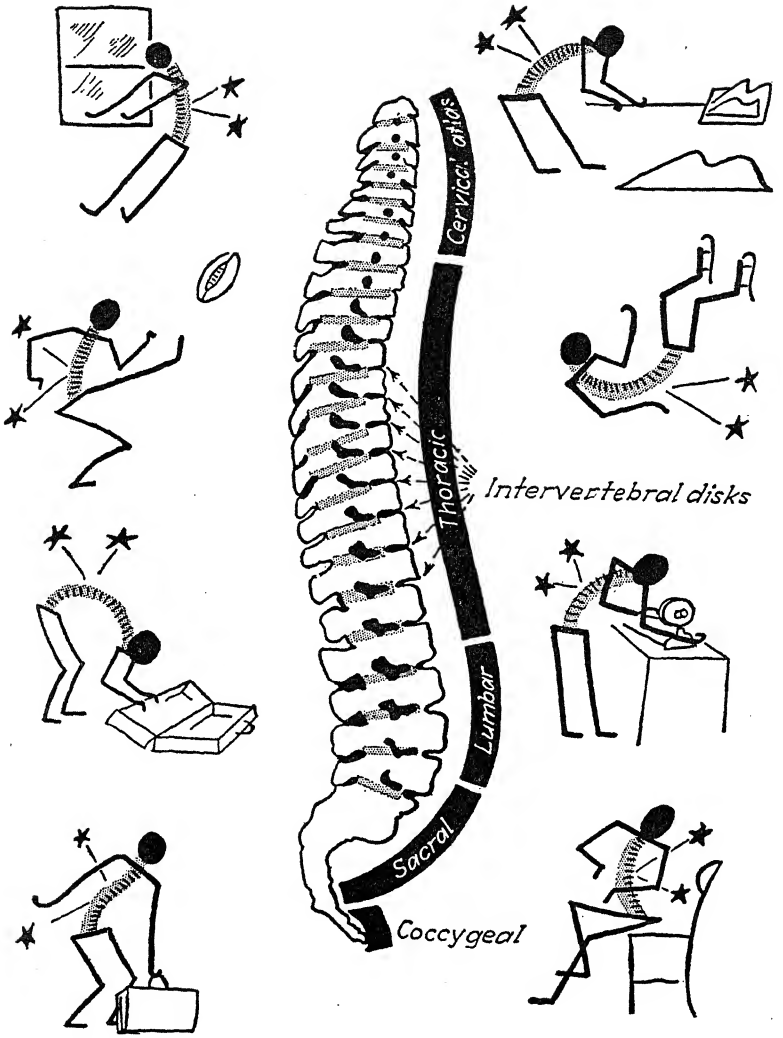
FROM HOUSEWIFE to great lady, from ditchdigger to oil company executive, everyone is subject every day to experiences that can injure his back. Climbing stairs, crossing streets, getting in and out of cars, driving tractors, playing football or golf or tennis, shoving desks around, and lifting heavy objects—any one of these can cause a back injury. The injury may be mild or severe, short-lived or prolonged; it may be single or multiple, and it may occur by itself or in conjunction with disease. It may be a slightly strained ligament or it may be a fractured vertebra. It may be a bruised shoulder or a crushed spinal cord. It may be an injury easily repaired and quickly forgotten, or it may mean spending the rest of one's days in a hopeless state of paralysis.

As life becomes more and more mechanized and contacts with moving machinery increase, chances for accident increase accordingly. The enormous number of people who crawl or are carried out of automobile wreckages and who subsequently prove to have strained muscles, torn ligaments, or broken necks bears witness to the dangers present in assembled horsepower. Automobiles account for about a million people—drivers, passengers, and pedestrians—killed and injured every year. The possible injuries to the back are myriad and include fractures, sprains, strains, disk injuries, dislocations, ruptures, contusions, and concussions, all of which are seen by doctors after automobile crashes.

The figures on industrial accidents include great numbers of men and women injured by other machines. By and large, industrial accidents occur because of defective machinery, improper methods of handling machinery, and carelessness on the part of the worker and employer. The largest number of injuries to the back occurs when the victim is struck by some heavy falling object and suffers fracture of one or more vertebrae. Sprains and strains of ligaments and muscles are also common. Since every occupation involves the overuse or abuse of certain tissues, each occupation has a typical physical injury associated with it. Railroad workers often suffer from fractures and dislocations. People who work with chemicals most often experience burns.

But machinery is by no means the only source of danger to the back. Home accidents account for many patients who come to doctors for help. Falls account for the largest number of these, and a great many victims are elderly men and women whose coordination, eyes, and balance are not so good as they once were. Misplaced or wrinkled carpets, objects piled on stairs, highly polished floors, and poorly lighted corridors and stairways are responsible for many back injuries. Stepladders or, even worse, makeshift substitutes for stepladders, slippery bathtubs, and stuck windows are all hazards to the back.

While serious athletic injuries are decreasing, there are still enough people engaged in sports to make it necessary to class them among the major causes of back injury. Team games such as football and basketball are responsible for a great many back disorders, but they probably rank behind golf and tennis, simply because so many more people play golf and tennis. Going into any game without proper warming up can, and often does, cause injury. Practice results in more strained muscles than playing.



Rough sketches of regions of spinal column viewed from the side, surrounded by figures showing some everyday acts that cause back troubles, such as opening a window that is stuck, kicking a football, carrying a suitcase, shoveling snow, skiing, etc. (*Lewin, courtesy of* Hygeia, *December,* 1945)

In practice one goes through the same movements of the body, arms, and legs repeatedly, thus throwing unusual strain on a few muscles. In actual play the player performs one movement, using one set of muscles, and then goes on to another movement, using another set.

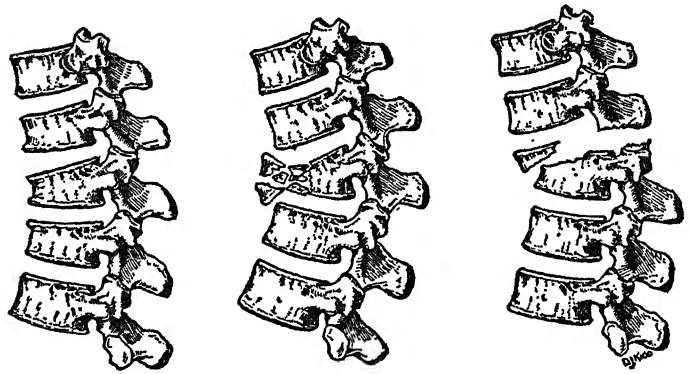
Because of the intimate relationship of all the parts of the back to one another, a very minor back injury can sometimes cause major distress and affect secondarily many parts not originally hurt.

Vertebral Injuries

The number and severity of vertebral injuries are increasing with the speed-up of mechanical and industrial life. Because of this increase, fractures and dislocations of the vertebrae have been given more attention by doctors and, consequently, they are being diagnosed earlier and more accurately and more prompt treatment is being applied. The results are fewer deaths and less disability from "broken backs" and "broken necks." The improvement of X-ray equipment and technique has been a great aid in early diagnosis.

Because of the peculiar structure of the spinal column, most fractured vertebrae are results of forcible bending of the spine by indirect mechanical forces. The outside portion of the column, you recall, is made up of the arches of the vertebrae and their processes, or arms, to which muscles are attached. These are all solid bone and interlock with each other in a series of intricate joints. The inside of the column, toward the abdomen and chest, is composed of the vertebral bodies and the intervertebral disks that cushion and separate them. The bodies are made up of a spongy bone and the disks are of soft tissue. Because the forward parts give more easily under pressure, the

spine almost invariably bends forward when sudden and forceful pressure is applied to it. The pressure may occur when a person falls, is thrown, or dives and lands on his feet, buttocks, head, neck, or shoulder, or when some heavy object falls and hits him on the head or back. The tendency of the column to bend forward (or flex) is strengthened by the protective "duck-your-head" reflex, which causes a person to bend forward involuntarily and instantaneously when his head is touched unexpectedly or even threatened.



Types of fractures of the vertebrae. (*R. Watson-Jones, courtesy of British Medical Journal*)

The most frequent fractures occur, therefore, in the bodies of the vertebrae. Great force is not necessary. Pain, tenderness, disability, and deformity indicate that a vertebra may be broken. The back is generally weak and stiff, and the injured person cannot extend it voluntarily. X rays are imperative for accurate diagnosis.

Reducing the treatment of fractured vertebrae to its simplest terms, it may be said that the doctor:

(1) stretches the spine out to its greatest possible length, using one of several possible frames or impromptu devices (he does this to take away all pressure and weight from the injured vertebra and thus to make reduction and healing quicker and easier),

(2) sets the fractured vertebra (that is, by means of manipulation or by simply stretching the spine, he puts the broken pieces together in their proper relationship),

(3) puts the injured person in a cast to make sure that no movement of the spine disturbs the broken vertebra while it is knitting together.

The earliest possible treatment of a broken vertebra is the best treatment. The longer the bones remain out of place, the greater is the amount of injury to other tissues surrounding them and the greater is the difficulty in eventually setting them.

If the vertebra does not heal properly, surgery may be required. In this case, a fusion operation is performed to limit the movement of the injured vertebra and to make it possible for the injured person to use his back again.

The most dangerous complication occurring in vertebral fractures is spinal cord involvement. There is always the possibility that a broken vertebra may injure, or even sever, the cord. If the injured person is unable to move his legs and has lost control over his bowels and bladder, even the layman can assume that his spinal cord has been injured. As in all cases of paralysis of the lower half of the body (paraplegia), urinary infection is the immediate threat to life. Paralysis of the bladder leads to retention of urine, with possible overflow, and results often in infection beginning in the bladder and ascending the urinary tract to the kidneys. This is a grave condition. In cases where the cord has been injured, attention must be concentrated on

care of the bladder, including proper and frequent emptying. Laminectomy, which means removal of part or all of the back shell of a vertebra, is usually performed to determine how badly the cord has been injured.

Of all the back vertebrae that can be broken, the twelfth thoracic and first lumbar segments account for 80 per cent of injuries. This is because of their mechanical function and the fact that they have more free motion than their brother vertebrae. Most injuries to them occur in accidents in heavy industries (such as coal mining) and are caused by some heavy blow (as from a falling girder or a cave-in) on the shoulders or the nape of the neck. The blow lands, the victim bends over sharply, and one or both of these two extremely susceptible vertebrae are broken.

It is always difficult for a doctor to say just what the outcome of any back injury will be, and this applies to fractures as well as to any other injury. Recovery depends on the patient's age and general physical and emotional condition, the kind of fracture he has sustained, the presence or absence of complications, and the length of time that has elapsed between injury and treatment. Furthermore, fractures vary widely in their severity, ranging from a single crack to a completely shattered vertebral body. If the cord and nervous system are involved, the case is more serious. Even the simplest, most uncomplicated case may require months to heal, though recovery is usually complete and the patient suffers no difficulty after the long siege is over. Often even the worst fracture can be treated so that it heals perfectly and leaves the patient little the worse for his unfortunate experience. However, it is frequently necessary for the recovered patient to turn to lighter work than formerly. Once a vertebra

has been broken, it is unwise to put too great a strain on it again. That's simply asking for trouble.

Because of the weight of the head and their own ease of motion, the cervical vertebrae, or those in the neck, are especially vulnerable to injury. Unlike the others, the cervical vertebrae are most often fractured or dislocated because of some force applied to the head, instead of to the back. Blows and falls again are the most frequent causes of trouble. One writer has estimated that automobile accidents are responsible for about 58 per cent of broken necks and falls for 24 per cent.

It happens sometimes that a person breaks a vertebra in his neck without knowing it. Persons have suffered from broken necks simply because they turned their heads abruptly or made some other perfectly natural but exaggerated motion when the muscles of the neck were relaxed and unprepared for movement. Normally, the neck muscles are strong and taut and prevent such freak accidents.

A broken neck vertebra will cause pain and stiffness in the neck, with the pain frequently radiating down through the shoulder muscles and into the arms and hands. The injured person cannot turn his head quickly and holds it oddly. Nodding "yes" and "no" movements are hard to make. Though these are fairly explicit signs of fracture, exact diagnosis can be made only with X rays. The pictures, if made from several angles, usually show the fracture clearly.

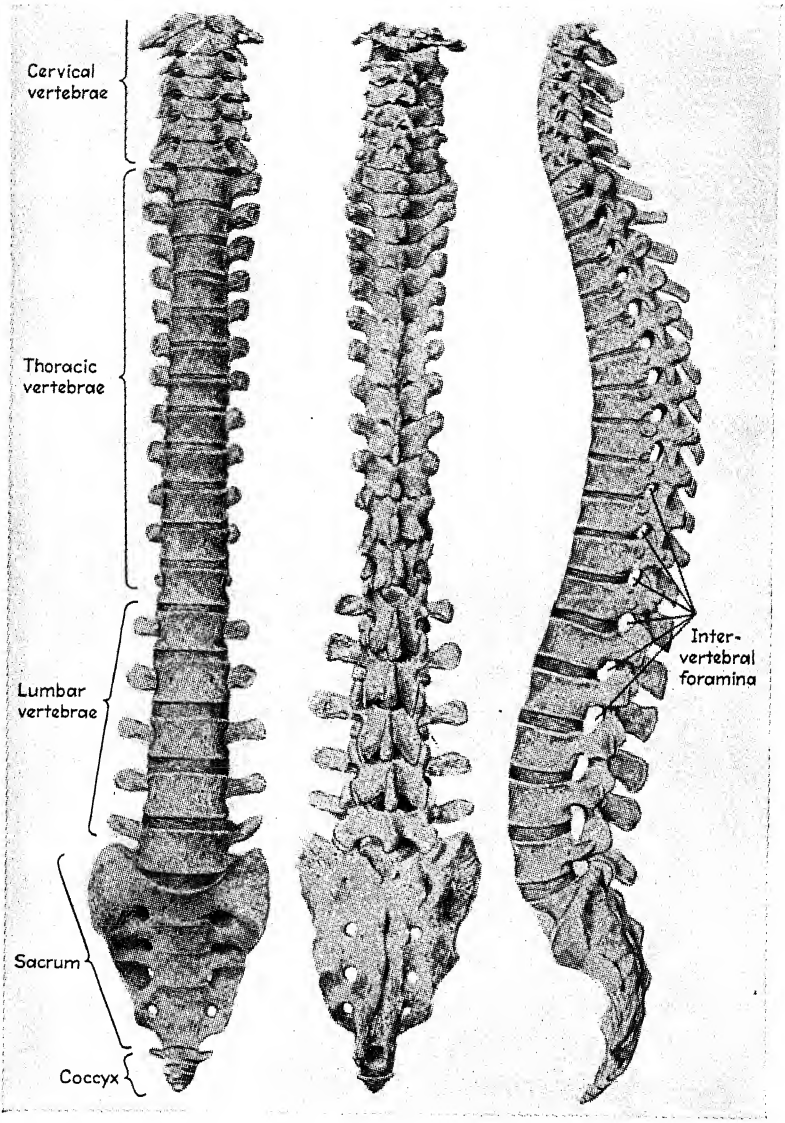
As in the case of fractures of other vertebrae, cervical vertebral fractures are treated by traction, or extension of the spine, manipulation, and immobilization in a plaster cast, with, of course, complete rest in bed. Sometimes a fusion operation is necessary if proper healing does not take place. The most important thing in treatment is to prevent the head and neck from

moving even so much as a fraction of an inch. The injured person's head must be held straight, with the chin up. Any forward bending of his head may crush his spinal cord, and that is a far more serious matter than the original fracture, even though a simple broken neck is no laughing matter. The nearer the chin is to the chest, the more likelihood there is of cord injury.

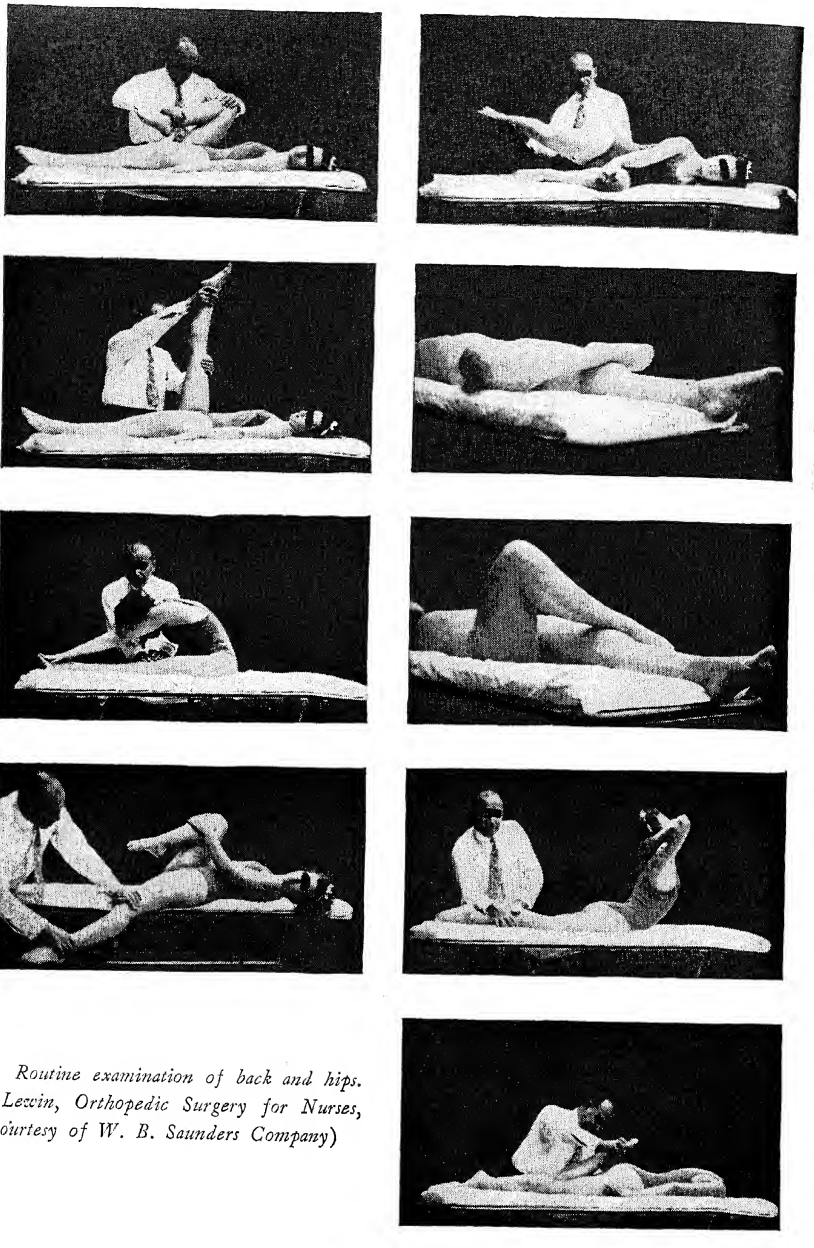
Dislocations occur more often than fractures in the cervical vertebrae, and the exact opposite is true of the thoracic and lumbar vertebrae. Dislocations happen in much the same way as fractures and for just about the same reasons. As with fractures, dislocations are experienced where range of motion is greatest, which explains why they are found so frequently in the neck and why the greatest number of all affects the fifth and sixth cervical vertebrae. It is not easy for doctors to distinguish fractures from dislocations. Rigidity is caused by spasm of the muscles in the area, which tighten up to prevent the injured area from being moved. It is a means devised by nature to safeguard an area that can no longer protect itself.

Because of the shape of the vertebrae and their connections with each other, the upper vertebra is displaced in front of the lower in a dislocation. The dislocated vertebra, in other words, is forced over and in front of its neighbor below. This causes the victim's head to swing around and bend toward the uninjured side. It cannot be bent in the direction of the injury. As in the case of fractures, X rays make exact diagnosis possible, though sometimes views from many different angles (including a projection through the patient's open mouth) are required.

Fracture occurs so often coincidentally with dislocation that it can almost be said that dislocation presupposes fracture. When fracture appears with dislocation, however, it is likely to be in one of the bony processes of the vertebra, rather than in the



The vertebrae. (*Sobotta, Atlas of Human Anatomy, courtesy of Hafner Publishing Company, Inc.*)



Routine examination of back and hips. (*Lewin, Orthopedic Surgery for Nurses, courtesy of W. B. Saunders Company*)

body. Cord injury sometimes occurs, and the rule about keeping the neck stretched out and the head straight holds with dislocations as it does with fractures.

The intervertebral disk is likely to be injured severely in dislocations because of the resulting unnatural pressure on the soft tissues of the disk. Destruction of the disk, with debris backing up into the spinal canal, increases the likelihood of cord injury or pressure. Traction applied to the head will sometimes remedy this condition, at least partially, since it gives the disk debris a chance to slip back into the cavity where it belongs.

Just as in fractures, the regular treatment procedure is to stretch the spine by means of traction, to slip the vertebrae back into their proper places (sometimes traction alone will do this), and then to see that the patient's neck is kept absolutely motionless until healing has occurred. A cast or some similar immobilizing apparatus is necessary.

Treatment is complicated by the fact that it is often started late. Since pain is slight when the neck is held still, the injured person is inclined to treat the matter lightly until it has gone on for some time, and the longer the time that has elapsed before treatment is begun, the less successful that treatment will be; this cannot be reiterated too often. In all cases of back injury (and, indeed, in practically every disease or abnormal condition of the body) the longer the condition persists without competent attention, the greater foothold it gains and the less optimistic the doctor can be about the eventual outcome. The worker who laughs at the "crick" in his back and refuses to go to the first-aid station or to see the company doctor is hazarding his whole working future.

Although many patients are carried through dislocations, as well as fractures, with little or no resulting disability, it would

be foolish to suggest that the outlook is always promising. Many people die from broken necks or dislocated cervical vertebrae, with their frequently associated fractures. This is due partly to injury to the spinal cord and partly to other injuries, such as fractures in other bones or damage to internal organs. An accident violent enough to cause a broken neck or back is often violent enough to cause other damage as well. However, prompt treatment and absence of complications can generally assure recovery.

Fractures and dislocations of the coccyx, or "tail bone," are most often caused by direct injury and particularly by a fall in which the person lands hard in a sitting position. After such an injury, the victim finds that sitting for more than a few minutes brings on pain (which, by the way, is more severe if the seat is soft) and that bowel movements cause discomfort. Tenderness and swelling are sometimes present, too. Pain may extend down the back of the thigh.

Coccygeal pain occurs with surprisingly greater frequency in women than in men. Though the reason for this has never been positively proved, one doctor who has studied the subject in detail believes that the coccyx is more prominent and therefore more vulnerable to injury in women.

In diagnosing coccygeal troubles, rectal examination is the most valuable procedure. With the patient lying on his left side, hips and knees bent, the doctor inserts his gloved right index finger into the patient's rectum. With his thumb on the outside of the body, he is in a position to feel the coccyx and discover the extent of the injury.

Nonoperative treatment, often successful, includes hot sitz baths, massage (through the rectum), manipulation, and strap-

ping the pelvis. If these measures fail to relieve the pain, the coccyx is generally removed. The operation is a relatively simple one and is almost always successful.

Muscle and Ligament Injuries

Sprains, strains, concussions, and contusions are the muscle and ligament injuries most often seen by doctors.

The difference between sprains and strains is one of degree. A strain is an injury occuring to one of the soft tissues when the tissue (muscle or ligament) is suddenly required to do more than it can handle and the excessive force is applied for a very brief period of time. Opening a stuck window is one frequent cause of a strained back. Trying to lift objects that are too heavy and lifting objects when the body is poorly balanced are other prominent inciting incidents. A strain is an unimportant injury that, if permitted to heal undisturbed, usually causes little trouble and clears up quickly. However, it may become chronic.

A sprain occurs when a joint is suddenly twisted or wrenched and the binding ligaments stretched until they are torn or separated from their attachments to the bones of the joint. A twist or sudden turn, such as climbing into an automobile or catching a heel in a torn rug, may result in back sprain. The condition is very painful because of injury to the nerves of the sprained ligament.

You have probably heard people say that "a sprain is worse than a break." This is not true. What *is* true, however, is that sprains are much more often neglected than breaks and, consequently, become chronically painful.

Adhesive strapping, rest, and cold applications are most successful in treating sprains. Cold applications should be applied

immediately after the injury occurs and then, three or four hours later, should be replaced with heat. Gentle massage is also helpful and, as soon as the patient can stand it without great pain, the sprained tissue should be exercised. Relieving the injured person from the pain he is likely to be suffering sometimes helps to promote quicker recovery, and injections of an anesthetic drug, such as novocain, may be made for this purpose. Relieving the pain causes the taut muscles to relax and makes it possible for the patient to use the injured part. However, in some cases, and especially before an X ray has been made, it is not wise to use such an anesthetic. Pain is, after all, a warning that damage has been done and that further use of the damaged part may increase the injury. Anesthesia turns off the warning signal. The doctor has to use judgment about injections for pain relief, and he should not be urged to use them when he thinks it unwise.

Contusions, or bruises, of the back are generally caused by a blow or fall. Broken blood vessels allow hemorrhage into the muscle fibers and other tissues and beneath the skin. Rest, cold applications, and very gentle massage usually are sufficient to encourage the bruise to heal rapidly.

Concussion of the back occurs during industrial blasts or, as was seen during the war, from the blasts of exploding bombs. It is a condition hard to define. The term really refers to any condition in which a part of the body suffers a violent shaking up, with resulting decrease in usefulness. However, no specific organic disturbance can be found.

If a muscle has been injured, pain on movement of the muscle follows. The pain is usually worse when movement is resumed after a period of inactivity. In most cases the injured area becomes swollen and tender. If the injury has been severe enough to tear

the muscle fibers apart, the doctor can usually feel the break, which gets larger when the victim moves the muscle. When such a tear occurs, it causes a sharp, stinging pain, as if from a whiplash—some patients have even heard a snap—and the back suddenly becomes weak and powerless. Graduated exercises, simple at first and then increasingly strenuous as strength and ease of movement return to the muscle, are the most important phase in treating such injuries.

Immobilization of the injured area is important in all cases of back injury, largely because it prevents many complications. Rest is always necessary.

Tips to the First-aider

Serious back injuries are likely to happen when no doctor is around to care for the injured person immediately. Therefore it is up to everyone to know something about what should and what should not be done when an automobile, industrial, athletic, or home accident occurs and some unfortunate is left with a back injury—especially a broken or dislocated vertebra.

The best rule for the untrained bystander to follow is *Do Nothing!* All too many spinal injuries are made worse by well-meaning people who "can't bear to stand by and do nothing while the poor man lies there suffering."

An injured person should be kept lying flat on his back until an ambulance or truck comes to move him to a hospital. A person with a back injury should never be transported by automobile in a sitting posture because of one basic and all-important fact: *Any movement of the spine, and particularly a forward-bending movement, is likely to cause the broken or displaced vertebrae to crush the spinal cord.*

A fractured vertebra can heal completely. A crushed spinal cord will never get well, and the man will be paralyzed for life. He should, therefore, be moved in a truck or ambulance, where he can be kept lying flat.

If a broken back is suspected, it is best to transport the injured person lying on his face, thus eliminating any possibility of his back being flexed. In fact, this position starts the basic treatment procedure of extending the broken spine. He can be rolled gently over onto a blanket and the blanket can be lifted and placed on a stretcher. If the blanket sags, no harm and even, perhaps, some good is done if he is lying on his face.

If the neck appears to be broken, the person should be transported lying on his back on a board, plank, or something similarly rigid. His head should be held steady, and body and head should be moved together when he is placed on the board. His chin should be held up—the head must never be allowed to bend forward. A cotton collar or wool muffler is advisable.

If the injured person complains of pain in the back, his back may be broken. If he has pain in his neck, his neck may be broken. If he cannot move his legs, his back may be broken and the spinal cord injured. If he cannot move his fingers, his neck may be broken and the cord injured.

The most important thing to remember always is this: *Never let a person with a back or neck injury sit up or in any other way bend his back.* If he sits up, he will fold like a jackknife at the point where the bone is broken and the spinal cord will be crushed.

CHAPTER XI

Arthritis of the Spine

THERE IS probably no disease that has a longer recorded history than spinal arthritis. The skeleton of one of man's remotest ancestors, *Pithecanthropus erectus,* dug up in Java and believed to be 500,000 years old, shows that he was afflicted with it. So was the Neanderthal man, a comparatively recent (only 25,000 years old) grandfather. The most ancient of the Egyptian mummies show clear evidence of the disease. Excavations prove that it was prevalent among the Indians of North America long before Columbus landed. The Java and Neanderthal men, the American Indians, and the ancient Egyptians probably found arthritis just as painful and as debilitating and deforming as do the people who suffer from it today; but there is one important difference between their sufferings and those of their modern descendants—the latter have a chance to prevent its happening and to relieve it when they have failed to stop it. Their ancestors had to grin and bear it, though it's doubtful that even the most stoic person with an advanced case of arthritis has much to grin about.

There are two distinct types of vertebral arthritis with different characteristics and results. One is the rheumatic variety, the other the degenerative type. Rheumatic (or, more correctly, rheumatoid) arthritis attacks young people, and degenerative (or osteo-) arthritis is a disease of middle or old age.

Arthritis is a disease of the joints, and considering the great number of joints found in the back, it is not at all surprising

that it should so often attack them. Nor is it surprising that advanced arthritis of the spine can lead to great deformity. The disease has so many joints to work on that it can affect the whole length of the back and interfere greatly with its functions.

Among the general factors that make a person susceptible to arthritis are physical or mental fatigue or strain, prolonged overexertion, poor posture or obesity and the disturbances in the body's functioning that they cause, disturbances in the metabolism or endocrine glands, poor nutrition, insufficient exercise, and exposure to cold and infections. Congenital defects, infection, and the stresses, strains, and injuries resulting from occupation are local causes that may precipitate an attack of arthritis. Many patients are found to have experienced some emotional shock just before an attack, proving that it sometimes has psychosomatic origins. Heredity, body constitution, and abnormal body build contribute to the frequency of arthritis. It attacks many women during the menopause.

Overwork and the wear and tear of the years cause degenerative arthritis, the disease of old people.

Rheumatoid arthritis is an infectious disease for which the streptococcus is usually responsible. It begins with a focal infection (in teeth, sinuses, etc.) with subsequent spreading to the spine when conditions are favorable, as in one of the situations mentioned above.

Pain, following a characteristic pattern, is the first prominent symptom of arthritis. First there is considerable pain when the arthritic person gets up after a time spent lying or sitting down; he finds that the pain is relieved after he moves about for a while; but after a little more activity it returns. Some doctors think this pattern may be due to the fact that during sleep the muscles, which have been tightened protectively around the

affected joint, relax. Therefore, when the person arises, the joint is unprotected and free to move about, causing pain. After a little of this, the muscles tighten up again, providing protection and bringing temporary relief.

If the lumbar, lumbosacral, or sacroiliac regions are involved, the pain may be referred to the sciatic nerve and the patient experiences sciatic pain.

All persons with arthritis complain of great fatigue. One doctor has said that this is because they are "tired from fighting the infection." Whatever the cause, the fatigue can be demonstrated objectively in the frequent subnormal morning temperature, poor pulse, low blood pressure, lowered metabolism rate, and poor muscle tone.

Changes in barometric pressure, dampness, and cold cause increased pain in arthritis. This is due partly to the effects of weather directly on the disease and partly to the effects of the weather and its abrupt changes on other parts of the body. During the cold, wet seasons, the body is weakened from fighting head colds and other infections and arthritis is able to get a firmer foothold than it can in warm, dry weather, when the body generally is in a healthier state. Changes in air pressure have distinct and measurable effects on the blood pressure and, consequently, on the blood supply. This, in turn, affects infected or otherwise involved joints.

Two types of deformities are seen as results of long-standing arthritis. In one type the back is rounded out in a kyphos from the hips to the neck and the head protrudes. Any attempt to straighten the spine produces great pain and, in time, becomes impossible. A perfectly straight, poker back is the other type. In other words, the disease either exaggerates or obliterates the normal spinal curves. Both types are the results of fusion of the

intervertebral joints in the position the arthritic person assumes for comfort. If the fusion is complete, the sick person is unable to turn his head or back and must move his whole body if he wants to look behind him.

There are other signs that indicate arthritis—signs that would perhaps seem to have little bearing on the case. For one thing, the arthritic's palms and the soles of his feet are usually cold and perspire freely. His nails are hard, brittle, and ridged, and his skin is dry, glistening, and parchmentlike. Constipation is common.

Oddly, it has been observed time and again that persons with rheumatoid arthritis are underweight and that persons with degenerative arthritis are overweight. The blood sedimentation rate parallels the course of rheumatoid arthritis, since it is an infectious disease, and helps further to differentiate it from degenerative arthritis, which is noninfectious.

Though the blood sedimentation test is the most valuable laboratory aid to diagnosis, other tests of the blood, urine, stools, basal metabolism, and various bodily secretions are often helpful. X-ray findings are important, though the disease must be moderately advanced before bony changes show up in the X-ray films. X rays of the teeth, sinuses, gastrointestinal tract, and genitourinary system should also be made to help locate focal infections. Once the results of laboratory and X-ray examinations are added to the physical findings, diagnosis is a fairly easy matter.

Arthritis is a disease that develops slowly. The type that affects young people may be present for from five to seven years before the victim is aware of it. Young, healthy men, often athletes, are most often attacked. In fact, fourteen men to one woman suffer from this kind of arthritis. Wandering pains or

"growing pains" in children may be warnings that arthritis is developing in the joints. If found and treated early, deformity can be prevented.

Degenerative arthritis, a disease of worn-out tissues, comes frequently as the aftermath of a lifetime of hard work. One writer estimates that from 60 to 70 per cent of all people over fifty years of age suffer from it.

The treatment of vertebral arthritis is similar to treatment of other diseases and conditions of the spine. Rest is the cardinal measure and, as in other conditions, immobilization of the affected back by supports, braces, casts, and so forth is often helpful. In certain cases, though by no means all, manipulation of the spine under anesthesia gives relief. Physical therapy, including heat, massage, special baths, and ultraviolet radiation, has proved of aid in many cases, and artificial fever, a relatively new and promising method of treatment, has been found helpful.

Since many cases of arthritis can be traced to focal infections, the doctor always gives special attention to finding and eradicating these. It is his aim to build up the arthritic patient to the best possible general health and, consequently, the ailing person's diet comes in for considerable scrutiny and adjustment. Cardinal Gibbons is reported to have said that he owed his good health to his bad digestion. This might be altered by adding that if there were more dyspeptics, there would be fewer arthritics. The person with bad digestion watches his diet carefully because he *has* to and, as a result, his nutrition is usually better than that of the person who boasts of a cast-iron stomach. Nutrition plays a prominent part in arthritis and its treatment.

Parallel with this point on nutrition is the fact, so often noticed, that arthritics fall into the classification of either over-

weight or underweight. When this is the case, the doctor's aim in nutritional treatment is to reduce or build up his patient to normal weight for his age, height, and general body build.

The adverse effects of weather changes on arthritics have been mentioned, and so it stands to reason that moving to a mild and relatively unchanging climate often gives the surprised arthritic relief from his pain. The southwestern part of the United States, where the altitude is about 1,000 feet and the soil and atmosphere are dry, has the climate best suited to him. If, as is generally the case, the arthritic cannot move to a more healthful climate, a great deal can be done in his home to provide more or less unchanging conditions of warmth and humidity.

Sessions at spas located near warm springs sometimes give the arthritic temporary relief, but he generally finds that his symptoms return shortly after he comes home, and the good done by bright sunshine at the seashore is usually offset by the dampness that accompanies it.

Pain-relieving drugs, given during the acute stages of arthritis, are valuable, and there are other drugs that prove beneficial in certain cases. However, there is none that we can say is specific for all cases. Vaccines are sometimes administered and are helpful in some cases. For arthritis that has its beginning during the menopause, injections or tablets of stilbesterol, the female hormone, have given relief in a great many cases.

Though surgery for spinal arthritis is not always advisable, in some cases it is employed with benefit. In instances where it is obvious that natural fusion of the vertebrae is going to take place, the fusion may be accomplished immediately by surgery and the period of painful natural fusion thus cut short. In extreme cases, where pain is agonizing and cannot be relieved by ordinary means, the spinal nerve roots are sometimes cut.

The patient's attitude toward his disease makes much difference in his success in living with it. He should know that he has a chronic disease and that, therefore, he must adjust his life and habits to its demands. He should avoid physical and mental strains, constipation, and the foods to which he is sensitive. He must banish worry. He must sleep and eat well and follow all the rules for general good health. Because arthritis is a tiring disease, he should spend a few days in bed now and then.

One writer says that "arthritis may be as inconsequential as gray hairs or more agonizing than death." The severity of cases of arthritis actually does vary that much and so does the outlook for arthritics. In practically all cases, proper treatment will result in improvement, though the extent of success depends largely on the stage at which treatment begins. Early attention may be so helpful as to prevent deformity entirely. Late treatment can relieve pain, and that's about all. The disease naturally follows an up-and-down course.

Other factors that affect the outlook for the arthritic are his age, resistance, and general health and his cooperation with his physician. Unknown and adverse allergic reactions complicate and darken the outlook, and a history of arthritis in the family doesn't help to brighten it.

For all arthritic patients, however, a sincere word of cheer can be spoken. There is no doubt that one can look forward to greater comfort, less deformity, and a more hopeful future. The benefits of modern science are not by-passing the arthritic.

CHAPTER XII

Curvature of the Spine

AT A NUMBER of places up to this point the curves of the spinal column have been mentioned. By now it should be clear that the curves referred to were the *front-to-back* curves—the cervical, thoracic, and lumbar curves, which all normal spines possess. This chapter is concerned with another kind of curve—the curve from *side to side*, the *lateral* curve. It is not normal.

The normal spinal column is perfectly straight when viewed directly from the back. Not the slightest deviation to the right or to the left can be seen. When, on looking at a patient's spine and, perhaps, drawing along its course with a skin pencil or studying X-ray pictures of the column, the doctor sees a departure from the perfectly straight line, he says that his patient has a spinal curvature, or *scoliosis*.

If the curve's convexity points to the right, he says that the patient has a right curvature; if the convexity points to the left, it is a left curvature. If it is a left curve in the thoracic region, it is a left thoracic scoliosis, and so forth.

The curvature may be a simple "C" curve—that is, one long curve to either right or left. Again, it may be a compound "S" curve, with two bulges, one to the right and one to the left; even triple curves occur. The curve may be very small and even unimportant, with only one vertebra displaced, or it may involve the whole spine.

Generally speaking, doctors recognize two broad classifica-

tions of scoliosis. There are those cases that are postural or functional—that is, in which there are actually no structural changes in the compositions of the vertebrae or muscles, but which are brought about simply by faulty posture. The other type is called structural, or organic, and scoliosis of this nature comes as a result of such conditions as congenital deformities of muscles or vertebrae, undernourishment, muscle imbalance, unequal leg length, or paralytic diseases.

Improper balance of the muscles is closely tied in with any question of scoliosis. Muscles normally are balanced perfectly between one side of the body and the other, with only minor and unimportant variations. To the spinal column are attached directly 144 pairs of muscles, half on one side and half on the other. If, because of one of the factors mentioned (congenital deformity, infection, malnutrition, paralytic disease, etc.), the perfect balance between these two opposing sets of muscles is upset and one group becomes weaker than the other, the stronger set of muscles will *pull* the spinal column in its direction, simply because the weakened set of muscles is unable to hold its side steady against the force exerted in the opposite direction.

Changes in the muscles and bones of the back are not alone responsible for scoliosis. Deformities, either from birth or disease, in the legs, hips, or ankles may lead to distorted posture and eventually to spinal curvature. Operations on the chest and abdomen, tuberculosis of the lungs, extensive scars (as from burns), and even unequal vision can cause it.

A high shoulder, prominent hip, or prominent shoulder blade is a sign of scoliosis. In examining a patient with scoliosis, the doctor looks at his patient's bare back to determine whether or not his shoulder blades, shoulders, and the creases of his buttocks are level on both sides. The curves of his back are ob-

served, as well as the position of his head and the lengths of his legs. The doctor asks the patient to bend his body from side to side and observes that flexibility is greater toward the side that makes the curve worse.

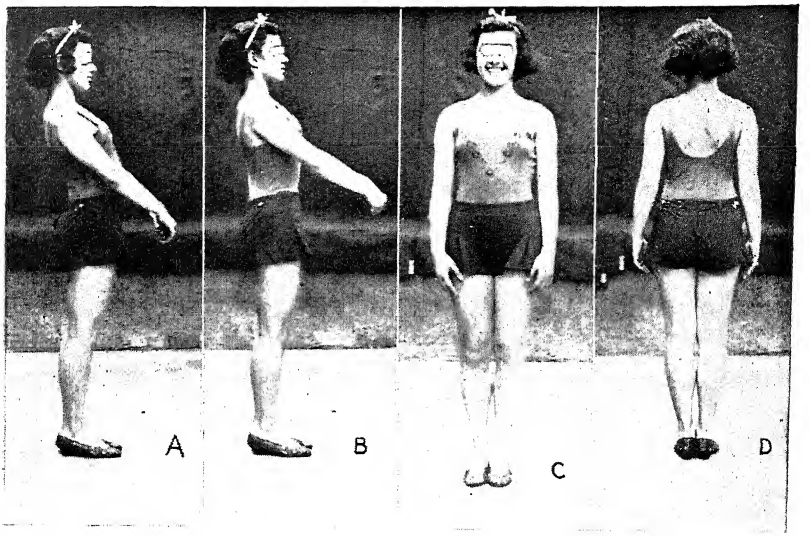
X rays provide a good means for checking the diagnosis and determining the type of curvature, as well as the best means for recording the progress of the disease and the results of treatment. A schematograph or silhouettograph provides a useful permanent record of the extent of deformity. A protractor may be used to measure the deformity shown on the X-ray plates.

The scoliotic patient may have pain because of the muscle tension produced by the body's attempt to retain muscle balance. Pressure on spinal nerve roots sometimes occurs, and this, too, causes pain. Pressure on the cord can also lead to one of the most serious complications of scoliosis, paraplegia, or paralysis of the lower body and legs. The deformity may lead to (or may be caused by) displacement of the ribs, with resulting crowding of the chest organs and lung, or heart disorders.

The outlook for the scoliotic patient depends on the type and severity of curvature, its causes, and the length of time it has had to develop before receiving medical attention. The rigidity of the soft tissues of the trunk and the general health of the patient, as well as the kind of treatment and the persistence with which it is followed, also affect the results.

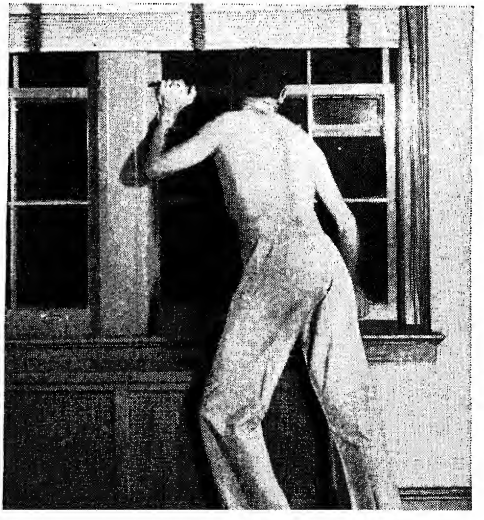
Scoliosis is primarily a disease of children and adolescents, and it has often been found that the curve increases in severity during the period of rapid growth and then remains stationary when the vertebral growth is completed (about the age of fifteen in girls and sixteen or seventeen in boys).

The best way to treat scoliosis is to prevent it. There is a period in all cases of scoliosis when the underlying pathological

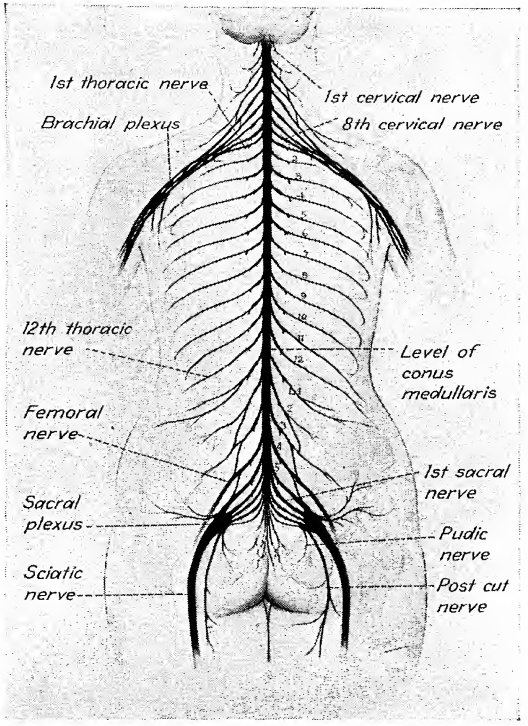


A. Poor posture due to throwing the shoulders back and nothing else. This produces sway-back and potbelly.

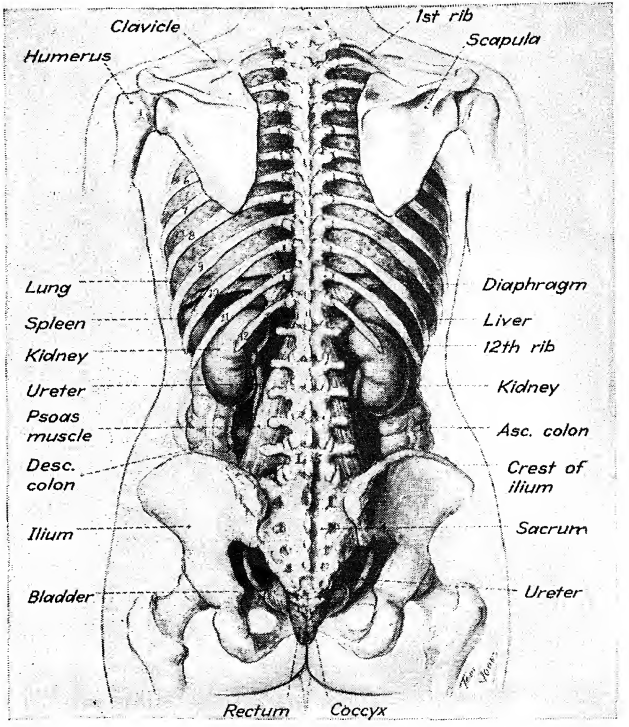
B, C, and D. Excellent standing posture from the side, front, and back. The arms are extended forward to expose lumbar region to view. (Lewin, Principles and Practice of Physical Therapy, courtesy of W. F. Prior Company, Inc.)



A common cause of acute backache—attempting to open a window that is "stuck." It may cause sacroiliac sprain, lumbosacral sprain, or protrusion of an intervertebral disk. This mechanism is exaggerated when the person has to clear some large mid-line object like the radiator pictured here. (Courtesy of Bernard Harris)



Posterior view of spinal nerves. Nos. 1-12, *thoracic nerves. Nos.* L1-5, *lumbar nerves.* (*Courtesy of S. H. Camp & Company*)



Transparent view of back showing relation of spinal column, ribs, pelvic bones, shoulder girdles, hips, lungs, kidneys, liver, and bowel. (*Courtesy of S. H. Camp & Company*)

conditions that cause the disease are present but when the actual deformity has not appeared. If preventive measures are taken here, the outward signs of deformity may never materialize. In many cases there is no way of recognizing the condition until deformity is seen, but in the case of scoliosis following poliomyelitis, chest infections, and other long-continued illnesses, spinal curvature may be anticipated and measures taken to prevent it. In cases that arise from imbalance of the pelvis (due, for instance, to unequal leg length) the shoes may be modified until the pelvis is balanced and scoliosis may never occur.

Special exercises for strengthening the muscles and equalizing their pressure after such diseases as infantile paralysis may help to prevent curvature. Desks and seats in schools should be given attention and defects of the eyes and ears remedied. The nutrition of children during the period of rapid growth should be carefully planned.

Correction of scoliosis is a long and tedious process that both the patient and his doctor are likely to find tiring and discouraging. However, if correction is to be accomplished, both must stick to the treatment, even though it takes years. The results are worth the effort—to the patient in the reduction of deformity, pain, and possible complications, and to the doctor in seeing his patient returned to an active life.

The first thing the doctor attempts in scoliosis is to straighten the primary curve. He does this by exercises (with the view of strengthening the weakened muscles) and by severe stretching, either by hand, with apparatus, or with the aid of a corrective jacket, or with combinations of these.

Failing in this, the doctor usually tries to *compensate* the spine for the curve. This is done by means of countercurves, a procedure that may seem strange to anyone not familiar with

medical practice but that actually has its basis in good mechanical logic. The original curve of scoliosis throws the body off balance. In the natural course of events the spine will develop secondary curves in the opposite direction in attempting to restore balance to the trunk. The doctor hastens this process. If the patient has a left thoracic curvature, the doctor will aid him in developing a right cervical and right lumbar curvature, so that his body will then attain nearly normal balance.

If the muscles can be strengthened to the point where balance of the compensated spine is maintained permanently without need of forcible correction in a cast or jacket, that is all well and good. Complete compensation means that the scoliosis now involves only the spine (not the pelvis and shoulders) that the trunk rests squarely on the pelvis, and that the head is centered.

If, however, the patient cannot maintain compensation and his body balance remains an unsolved problem—largely because of inadequate muscle development—surgery may be attempted. The patient is placed in a plaster cast or special frame bent to the corrective position. The fusion operation is performed through a window cut in the cast or through an opening in the frame (so that the correction will not be lost by removing the cast for surgery). The patient remains in his cast for several months after surgery, during which time the fused vertebrae become strong enough to stand the stress of weight bearing. After the cast is removed, the patient stays in a corrective jacket or metal frame for a few more months, meanwhile performing exercises to improve his posture and general muscle tone.

CHAPTER XIII

The Intervertebral Disk

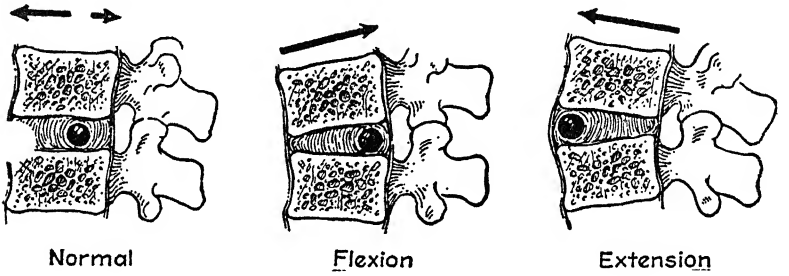
DOCTORS NOW generally agree that ruptured intervertebral disks are responsible for as much chronic low-back pain and sciatica as is any other single factor. Yet it is only within the past fifteen years or so that the abnormal disk has been studied consistently and recognized for the trouble it can cause. Before this, the symptoms now known to be caused by disk disorder were often attributed to various disorders of the spine or nervous system.

The normal disk performs a vital part in the efficient functioning of the back. It has been spoken of as a cushion, and this remains the best term to describe what the disk does. Placed between each two vertebrae, disks cushion the bony bodies of the vertebrae from each other, take up shock, and are indispensable in the spine's weight-bearing action.

Three well-defined elements constitute the disk. The central part, the *nucleus pulposus*, is a shapeless mass of tissue resembling boiled tapioca. It is extremely elastic and may be sharply compressed, only to return to its former shape as soon as the pressure is removed. Although the *nucleus pulposus* looks wet and jellylike, it is found to be tough if an attempt is made to cut it.

Encasing the *nucleus pulposus* is the *annulus fibrosus*, a laminated, onionskinlike covering, which normally is as tough as leather. As the spine bends and extends, sideways or back and forth, the annulus bulges and contracts and inside it the nucleus

is compressed and released. Without the disk the spine would lose a great deal of its length and flexibility, since the bony vertebrae, rubbing against each other, could have only an extremely limited range of motion. Above and below the disk is a cartilage plate, which reinforces the annulus at the points where the disk is in contact with the vertebrae.

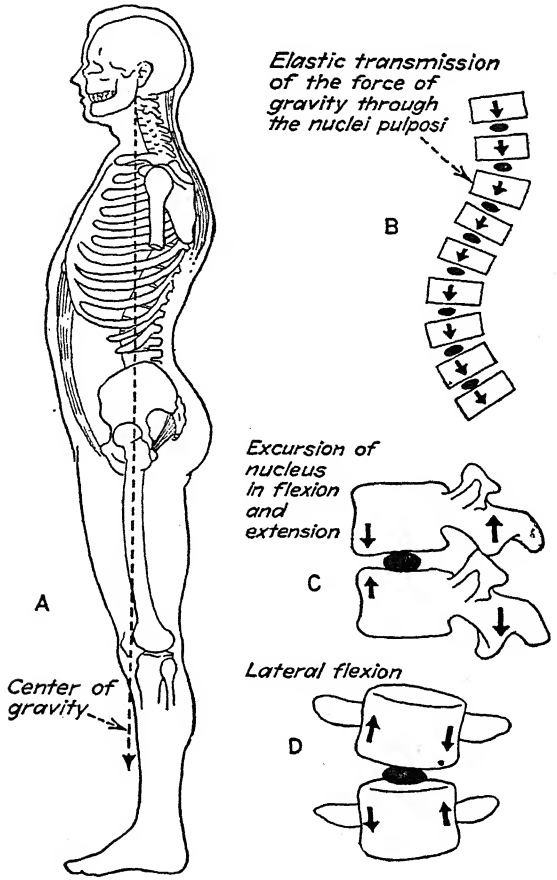


Intervertebral disk with nucleus pulposus. Normal excursion of nucleus during flexion and extension of spine. (*Lewin, Backache and Sciatic Neuritis, courtesy of Lea & Febiger*)

As was mentioned, the annulus is normally as tough as leather and holds the nucleus, even under great strain, without difficulty. Disk trouble occurs when the annulus is weakened. The process of degeneration of the annulus, which finally results in a ruptured or herniated disk, covers years, in all probability—years during which the annulus slowly loses strength to the point where pressure from the nucleus against its walls breaks the walls. Sometimes the break occurs spontaneously; sometimes it is brought on by undue strain. When the annulus gives way, the nucleus then ruptures through the opening and into the spinal canal, providing the posterior longitudinal ligament breaks.

So many cases of ruptured intervertebral disk occur in the

fourth and fifth lumbar disks and so few in other disks that this discussion will be largely limited to the former two. Why this should be so is a question that no one has yet been able to answer satisfactorily, but every investigator has found that



The mechanics and dynamics of intervertebral disks. Balance and transmission of force. (Adapted from Calvé and Galland; redrawn and modified in Lewin, Backache and Sciatic Neuritis, courtesy of Lea & Febiger)

around 90 or 96 per cent (the exact percentage varies with different investigators) of his disk patients suffer from ruptured fourth or fifth lumbar disks, or both.

By far the most prominent symptom of disk herniation is pain extending down the back of one or both legs. Rupture of the disk into the spinal canal in the lumbar area is an almost certain threat to the spinal nerves, and pressure of the ruptured nucleus on the nerves produces the characteristic symptom of sciatica and low-back pain. Other suggestive symptoms are exaggerated pain on coughing, sneezing, or straining at stool, disturbances of the ankle or knee jerk reflexes, and disturbances of sensations in the foot and leg. The behavior of the pain constitutes an important symptom, too. Almost everyone with a ruptured intervertebral disk finds that his pain comes and goes intermittently.

Though diagnosing a ruptured intervertebral disk is not an easy procedure, a doctor who is familiar with the condition can usually make a diagnosis from his patient's history and symptoms. However, in order to confirm his diagnosis definitely before operation in a case that does not seem to be typical, he can inject air into his patient's spinal canal and then take X-ray photographs. A block in the canal will show up in contrast to the injected air. Formerly iodized oil or pantopaque was used as a contrast medium, but it has been largely superseded by air.

A good percentage of ruptured disks are concealed—that is, the rupture is large enough to cause symptoms but too small to show up in X rays, even when a contrast medium is used. This constitutes another reason for not using iodized oil or even air. Too often X rays give negative results, even when a ruptured intervertebral disk is present.

Though there are a few other conditions with similar symptoms, differential diagnosis is usually not a difficult matter, since

the other conditions are uncommon and, in addition, have characteristic symptoms. Spinal tumors may simulate disk disorders, but they also produce some sensory or motor disturbance. A congenitally defective fifth lumbar vertebra, too, may produce disklike symptoms, but the defect will show up in the X rays. Spondylolisthesis must be kept in mind.

The surest cure for a ruptured intervertebral disk is surgery. Unless operation is performed and the ruptured disk material removed, the symptoms probably continue for the rest of the patient's life, or at least for many years. Good results are often seen from nonoperative, or conservative, treatment, but they cannot be depended on.

The surgical technique in the case of a herniated intervertebral disk has been steadily improved and simplified, and it can now be accomplished with the removal of only a tiny piece of bone—in many cases, none at all. There is usually no need to disturb the spinal cord in any way.

In many cases it is wise to perform spinal fusion in the area of the ruptured disk, either at the time the disk is removed or later. This is true in cases where the patient has had back pain for a long time and where the pain seems to involve factors other than the ruptured disk. In certain other cases, in which the patient must return to heavy labor, fusion will prevent a great many recurrences of pain and other difficulties.

There are few spine conditions in which the doctor can anticipate more certain or more complete relief than in the case of an uncomplicated ruptured intervertebral disk. The emergence of the disk as a major cause of low-back pain and, indeed, of most sciatic pain, with the resulting attention to surgery of the disk, has led to successful treatment of a tremendous number of people who, a few years ago, would have been considered to

have incurable and untreatable low-back pain and sciatica, as well as conditions mistakenly called sacroiliac strain and arthritis of the spine.

Those few cases of ruptured disks in the cervical or thoracic region offer threats to the spinal cord, and it is extremely important that they be diagnosed and operated on before the cord is involved or, at least, immediately after cord symptoms appear. Some contrast medium (such as pantopaque) is often necessary for early diagnosis of disk disturbance in these areas, since diagnosis here is not the simple matter that it is in the low back.

The reason why ruptured cervical or thoracic disks threaten the cord when the lumbar disks do not is that in the higher areas the cord is larger and fills the greater part of the spinal canal. In the lumbar region, the cord has dwindled away into the *cauda equina,* while, at the same time, the canal has enlarged. Lumbar disks can rupture and a great deal of nuclear material be cast into the canal before the nerves are even touched, to say nothing of being compressed. In the cervical or thoracic regions, even the most insignificant amount of material in the canal constitutes a hazard to the cord.

CHAPTER XIV

Sacroiliac Pain

I'VE GOT a strange click-clack in the back of my sacroiliac," ran the words of a popular song in which the South Americans were advised to take back their rhumba, conga, and samba. Though it's doubtful that a "click-clack" noise is ever heard in the disturbed sacroiliac joint, it's perfectly possible that a violent rhumba might lead to sacroiliac disorder, since most of the pain experienced in that region is due to some injury sustained while the body is twisted. There's much twisting necessary in the rhumba—and in the conga and samba, too, for that matter!

Before the causes of sacroiliac distress are discussed, the sacroiliac joint should be described. The word "joint" is enough to describe it in part. It *joins* the sacrum, and therefore the spine, to the pelvis. Unlike many other joints (like the knee or the elbow) it has little range of motion; only slight, gliding movements normally occur. After all, there is no need for it to move much. It is surrounded and reinforced by tough, resistant, well-developed ligaments, which serve to keep it pretty motionless. Again unlike many other joints, the sacroiliac is not sustained by muscles, which would give it more motion than ligaments do. The joints—there are two, one on each side of the sacrum—are large and firm. When you remember that they actually support the whole weight of the trunk and also absorb the shock transmitted by the legs in walking, the necessity for their solidity and immovability becomes obvious.

Because of the tremendous weight they support, the liga-

ments of the sacroiliac joints are under constant stress. Add to this normal stress additional strain from injury or infection, and the ligaments sometimes give way or relax their hold on the bones. The relaxation of the joint, which invariably follows, brings on pain.

Great force is not necessary to injure these already overburdened joints. Some of the simplest acts, things that are done every day, can bring a person up sharply with a "catch" in the back or hip, the sign that the sacroiliac joint has given up the battle to hold its own against an overwhelming force exerted against it. Movements occurring when the body is off balance or twisted are particularly likely to cause sacroiliac strain. Raising a stuck window can cause sacroiliac trouble, but the trouble is more likely to occur when a person is leaning sideways, like bending around a chair or radiator, to push up the window. Persons who stand astraddle and lift objects from one side to another, as structural ironworkers do, frequently complain of sacroiliac strain. Lifting a heavy or cumbersome object from a level lower than that on which one is standing is likely to cause it. Unlocking automobile bumpers is responsible for many strange "click-clacks in the backs of our sacroiliacs." You can even strain your sacroiliac joint if, after sleeping in a bad position during the night, you leap out of bed in the morning, hurry to the bathroom, and bend over the washbasin to wash your face.

Pain is the most noticeable symptom of sacroiliac disturbance. While the primary pain is in the region of the joint, it can often be felt in the back of the thigh and leg, too. Most patients say they feel pain in "the hip." It sometimes radiates upward as well as downward. Movement of the lower back is limited, partly because pain causes the muscles to stiffen. In addition to being stiff, the low back is also often tender and sensitive to

pressure. If only one of the two joints is injured, the victim tries to sit on the buttock of the uninjured side, thus avoiding putting weight on the disturbed joint. He cannot lie on the painful side, and he walks upstairs one step at a time, dragging the leg on that side behind him. He often finds that straining at stool increases the pain.

In addition to questioning his patient about his symptoms and the beginning of the pain, the doctor can apply certain physical tests to determine whether or not the difficulty really lies in a sacroiliac joint. He particularly asks the patient to bend, straighten, and lift his legs and hips. The point at which pain interferes or at which motion ceases tells the doctor a great deal. X rays are usually made, though in most cases of sprain or strain they show nothing helpful in diagnosis. If, however, the pain is due to arthritis, tuberculosis, or some other infectious disease, changes in the bones of the sacrum and pelvis will show up in the X-ray films.

The distribution of the pain—that is, where it appears—is also significant in the diagnosis. Pain is caused by pressure or other interference with the spinal nerves, and the doctor can often tell from the location of the pain just which nerves are being irritated. Since he knows where each nerve originates in the spine, it is a relatively simple matter for him, a trained observer, to figure out where the injury is. As mentioned before, pain in the back of the thigh almost consistently appears in sacroiliac disorders. If the patient complains of low-back pain with, however, no pain in the thigh but, instead, below the knee, the doctor suspects another condition (often lumbosacral) instead of sacroiliac disorder.

Since the range of movement of the sacroiliac joint is so small, dislocations of the joint are exceedingly rare. If a joint

can move only slightly, obviously it is hard for it to move enough to get itself dislocated. Dislocation does occur occasionally, however—usually as the result of some sudden severe injury. Dislocations of the first type are caused by much the same sort of injury as sprains and strains of the joint. Years of habitual faulty posture may cause the sacrum to become tilted and the joint to slip. The relaxation necessary for a dislocation may occur during pregnancy, too, because of excessive abdominal weight and the compensating, sway-back posture. It is not a permanent condition, however.

Characteristically, dislocation occurs when the person bends forward. If the ligaments are sufficiently relaxed, the sacrum may slip forward slightly on the joint surface, and, because the forward slip stretches the ligaments beyond their normal limits, a sharp pain is felt. The pain causes immediate muscle spasm, and the spasm, combined with pain, prevents the victim from straightening up. Since the joint surface is rough, the sacrum may slip back into place completely and become locked.

Manipulation, generally under anesthesia, is necessary to replace the joint surfaces. After manipulation the spine must be protected and supported until it is able to return to complete activity.

Many sacroiliac disorders such as sprains and strains may be treated effectively without any need for surgery. The patient must rest in bed, and the doctor most often applies traction to the legs and then a plaster-of-Paris cast or brace. Manipulation is often helpful, as well as medical gymnastics, including underwater gymnastics. Heat and massage frequently do much to clear up the disorder. Strapping, a light brace, or a well-made corset is generally necessary for a while afterward.

Infections of the sacroiliac joint, especially arthritis and tuber-

culosis, occur fairly frequently. Pain, tenderness, and limitation of movement are the prominent symptoms of arthritis and can generally be relieved by nonoperative treatment. Manipulation and support are the most important aspects of treatment.

In tuberculosis, as in other sacroiliac disorders, the chief symptoms are pain and limp. They are aggravated by standing and walking and are usually referred to the hip. They may be accompanied by sciatic pain. Sometimes the patient's body tilts, either toward or away from the diseased side. Scoliosis usually appears, and the pelvis is motionless. Often the patient holds his knees close together and takes short, rigid steps. He finds stooping difficult. An abscess frequently forms at the infected joint.

Osteomyelitis of the sacroiliac joint is sometimes seen, too, as well as other infectious diseases, particularly those caused by the cocci. Benign and malignant tumors occasionally involve this joint.

Surgery is often the only way to relieve infectious diseases of the sacroiliac joint. It is necessary to remove the diseased portions of bone and to replace them (usually at a later date) with healthy bone grafts. Patients who submit to this operation and are aided by penicillin stand an excellent chance of recovery.

CHAPTER XV

Tumors of the Vertebrae and Spinal Cord

USING THE BROADEST CLASSIFICATION, there are two kinds of tumors—benign and malignant. To call a tumor benign means merely that it is not cancerous, will not spread to the rest of the body, and may be cured even at a late date. A malignant tumor, on the other hand, is a cancerous one, and a cancer, if left to grow unmolested, will in time *metastasize*—that is, cells from the tumor will break off and move to other parts of the body, where they will take root and, following the example set by the parent tumor, grow in the new organ or tissue.

Both benign and malignant tumors may be treated, often successfully, by surgery or by irradiation with X rays or radium. The great fear with which people regard cancer is unjustified if a cancer is discovered early, before it has a chance to metastasize. If treatment is instituted then, the cancer may be removed. If treatment begins too late, even surgical removal of the growth will not save the person's life, because new cancers will appear and it is impossible to remove all of them.

There are many different types of both benign and malignant tumors, but no attempt will be made to differentiate them here. However, a difference between *primary* and *secondary* tumors will be indicated, since the results of treating these two may be vastly different. A primary tumor is an *original* tumor—that is, it is the first to appear in the body. Secondary tumors appear after a primary cancer in some other organ of the body—generally the breast, uterus, or prostate—has metastasized. In diag-

nosing a tumor of the spine, knowledge that his patient has had a breast, uterus, or prostate removed because of cancer is most significant to a doctor. Chances are that the newly recognized tumor in the spine is a cancerous offshoot of the original cancer —in other words, a secondary tumor.

Tumors of all types—benign and malignant, secondary and primary—may occur in the spinal cord and in the vertebrae. Cord tumors, however, are usually benign and subject to successful treatment by surgery. Malignant spinal tumors are generally confined to the vertebrae.

Spinal Cord Tumors

Tumors of the spinal cord often masquerade as ruptured intervertebral disks, and vice versa. It is easy to see how this might happen. Both tumors and ruptured disks place an extra, "space-occupying" mass in the spinal canal. As a result, they produce similar symptoms. A trained physician can distinguish between them by certain signs peculiar to each, but before the ruptured intervertebral disk was recognized as the frequent offender it is, ruptured disks were practically always diagnosed as tumors of the spinal canal.

Like the ruptured disk, tumors of the spinal cord cause symptoms along the course of the nerves, since they produce pressure on the cord and the nerve roots. Pain, however, is not an early symptom. Before pain appears, other signs are present. Rigidity of the spine, due to spasm of the muscles, is seen early. Later, after the tumor has grown very large, so many nerves may be compressed that the muscles become flaccid and completely paralyzed, instead of spastic and taut.

If certain nerves are interfered with, the person with a spinal

tumor may find that he is clumsy when he tries to run. An alarming symptom may be a sudden, completely unexplainable fall. His walk may become asymmetrical, and inspection of his shoes may show a decided difference in wear between right and left shoes. Sensibility may be disturbed, too, and the person may complain that his underwear is unbearably irritating. His feet may be wobbly, and his legs may move involuntarily. Sometimes there are tingling, burning, or "wooden" sensations. Among the symptoms particularly annoying to the patient is disturbance in control of the rectal and bladder muscles. The sexual functions may also be disturbed.

As a rule, there is no local tenderness at the site of the tumor. Pain, instead, is referred along the course of the nerves involved. Pain may appear in many different patterns, depending largely on the location and size of the tumor. Obviously, a larger tumor would interfere with more nerves than a smaller one, and equally obviously, a tumor situated high in the spine would affect different nerves from those located in the lumbar region. In any case, the pain is likely to be aggravated by coughing, sneezing, straining at stool, or compression of the jugular veins, since any of these increases the pressure of the spinal fluid. Pain in the nerve roots has a tendency to waken the sufferer at about three or four o'clock in the morning. Walking around sometimes relieves it. So does sleeping in a chair.

The history related by the patient and the physical findings made by the doctor in the course of various tests, including those for movement and sensibility, usually are enough to enable the doctor to make a diagnosis of spinal cord tumors. Examinations of the spinal fluid are helpful, too. If the patient's symptoms become worse after spinal puncture, the presence of some space-occupying mass is almost certain. X rays are sometimes

helpful. Even though the tumor itself is not opaque enough to cast a shadow on the X-ray films, the effect of the tumor on the size of the spinal canal will show up in X rays and will help locate the mass. A tumor naturally enlarges the spinal canal, which is outlined on the X-ray films. It may also erode parts of the vertebrae, and these changes can be seen on the films, too.

If any tumor, even a benign one, is allowed to go untreated, it may eventually grow so large and compress the spinal cord so extensively that complete paraplegia, or paralysis of the lower half of the body, occurs. The outlook in paraplegia is very unpromising.

Treatment of spinal cord tumors nearly always means surgery or irradiation by X rays or radium.

Tumors of the Vertebrae

The bodies of the vertebrae, as has been mentioned, are made up of soft, spongy bone. For this reason, the vertebrae are much more prone to develop cancer after metastasis of a primary cancer than are the long, hard, tubular bones. For the same reason the early changes wrought in the vertebrae by tumors are difficult to see on X-ray films. Spongy bones throw a much less dense shadow than solid bones, and considerable damage must have occurred before the difference becomes visible on the films. X-ray diagnosis is made still harder by the fact that the X-ray machine must view the spine through a thick layer of soft tissue—a layer much thicker than that covering a leg or the lungs. One authority has estimated that if more than 8 inches of tissue cover the vertebra being viewed, half the

vertebra will have to be affected before the change is visible on the X-ray films.

This difficulty is somewhat offset, however, by the fact that if the contour of the vertebra is affected, changes will show up quickly. Early in the course of a tumor, the normally smooth contour of the vertebra will begin to appear blurred. Later, the normal archlike outline develops unexpected angles.

As in so many other back disorders, the major symptoms of vertebral tumors are pain, tenderness, and limitation of movement. Pain, however, may be entirely absent, and in any case the type of pain often varies greatly among different people. In some, it is boring; in others, it appears as a dull, rheumatic ache; and in still others, it is sharp and knifelike. The area is usually tender to touch and sensitive to movement, and because of the latter, nature often renders the spine immovable. The pain is frequently more marked at night and is not relieved by bed rest.

In diagnosing vertebral tumors, the doctor considers his patient's age, his heredity, any previous spinal injuries, and, especially, any primary tumors in other organs. Generally speaking, tumors are most common in middle age, though there are certain types of cancer that are typically seen during or soon after puberty. A history of either benign or malignant tumors in other members of the family may be important, since there is evidence to indicate that a *tendency* toward these unusual growths is hereditary. Moreover, a malignant growth elsewhere in the body may, through metastasis, result in cancer of the vertebrae.

X rays, in spite of the difficulties associated with using them, remain the best aid in diagnosing vertebral tumors. A trained radiologist, by studying minute changes in the size, shape, and

outlines of a vertebra, can often describe the type and location of a tumor exactly, and his findings, combined with the history given by the patient and the results of the doctor's physical examination, generally enable the doctor to make a precise diagnosis. In cases where there is still uncertainty as to what the growth is, it is sometimes necessary to take a biopsy specimen—that is, to remove a bit of the growth and examine it under the microscope. Removing tissue for biopsy in cases like this, however, has been up to recent months a major operation in itself, and the dangers associated with it make it wise to employ the procedure only as a last resort. Simple technic has been recently perfected by Valls.

Many benign tumors can be completely cured by irradiation, either X ray or radium. Tumors in adolescents are particularly susceptible to radiation—much more so than those in adults. The pain of malignant cancer can often be relieved by radiation, too, though radiation cannot cure or eradicate the growth. Pain-relieving drugs are often given. Injections of calcium, especially in cases of benign tumors, help the destroyed bone tissues to rebuild themselves. In some cases, bone graft or fusion operations are considered necessary.

It should be pointed out again that any tumor, either benign or malignant, is most susceptible to cure when it is young and in the developmental phase. Even the least dangerous benign tumor may become unmanageable after it has grown to a large size. The danger of paralysis when such tumors have grown large enough to affect the spinal cord seriously have been mentioned. Even malignant tumors of the vertebrae, if they are not the result of metastasis—that is, if they are primary—are curable in their early stages.

For these reasons, an early visit to the doctor when *any* spinal

symptoms appear is the only sensible course for anyone. Many deaths and many pain-filled years of life are due to carelessness or timidity on the part of persons who delayed seeking good advice until their conditions were so far advanced that even the greatest medical skill in the world could not save them.

The science of medicine today offers everyone more life and more joy in life. It is a pity that this offering is so often rejected. Cancer ranks second only to heart disease as a cause of death in this country, and the number of deaths from cancer increases each year. Only the individual can reduce this toll, and he can do it only by requesting an examination by a physician as soon as he encounters any suspicious symptoms.

CHAPTER XVI

Backache and Overweight

PRACTICALLY EVERY ORGAN of the abdomen is attached in some way to the spine. If the weight of these organs, great enough in itself, is enhanced by pounds of fat, the load the spine has to bear is increased to the point where pain appears. Many chronically painful backs in which a physical examination reveals no sign of any abnormality are relieved when twenty or thirty or a hundred pounds of excess and unnecessary weight are removed.

Furthermore, overweight increases the severity of pain in such disorders as sacroiliac disturbance and vertebral arthritis. It makes recovery more doubtful, even under the most appropriate treatment. Fat prolongs the period of pain and disability following an injury to the back by hindering the healing and repair processes.

The hazards in surgery of the spine and, indeed, of any part of the body are increased when the surgeon is hampered by inches of fat tissue. The convalescent period is likely to be prolonged, too. Most doctors insist that, except in emergency operations, their overweight patients at least make an effort to bring their weight down to nearly normal before surgery is performed.

Overweight does harm not only to the spine but also to the vital abdominal and thoracic organs. The heart of a fat person is overburdened by excess weight and by the necessity of supplying blood to the miles of blood vessels that extra pounds of

fat add to the circulatory system. Under such strain the heart wears out sooner than it should. High blood pressure often develops in fat persons, too, as well as in those with blood-vessel disorders. Fat deposits on the kidneys prevent their functioning properly. The pancreas is often disturbed, and diabetes may develop.

In spite of the excuses many overweight persons like to offer for their excess fat—glandular disorders, hereditary factors, and so forth—they get fat for only one reason: They eat more calories of energy in food than their bodies are able to burn up in activity. Consequently, the only way to reduce weight is to reduce the amount of food consumed—in fact, diet.

Even when overweight persons have been told the dangers inherent in overweight and have been advised that their backaches are due entirely to too much fat, many of them find it difficult to exert the will power necessary in dieting. Or, as is sometimes the case, especially with women, they follow haphazardly dieting fads that leave them in a state of actual starvation. A good reducing diet, one recommended by a physician, gives the reducer all the necessary vitamins, minerals, and proteins necessary to his body's health. When there is any chance that the essential food elements may not be ingested in sufficient quantities in the food, additional food elements are prescribed in capsule or tablet form.

To be effective, the reducing diet must contain fewer calories than the reducer burns each day in energy. In this way only can he use up the fat already stored. It is obvious that a stenographer, to reduce, must eat fewer calories than a laborer, since anyone whose work requires much physical activity burns up many more calories than a sedentary worker does.

The diet will seem painfully slim to the reducer at first, but

as his stomach becomes accustomed to incomplete fillings, it will shrink and hunger pangs will become less sharp. Eventually the stomach will be accustomed to a greatly decreased amount of food and will be perfectly satisfied with it.

To make the first few weeks of dieting less painful, an appetite-reducing drug may be prescribed. Perfectly safe when taken in measured doses and under the prescription of a physician, the drug depresses the appetite and makes undereating much easier for the food-loving but determined dieter.

Exercise is a factor in reducing. Two exercises, especially, are most beneficial to the reducer. The first is a shaking of the head from side to side when second helpings are passed, and the second is a pushing movement away from the table while still hungry!

Persons are too much inclined to laugh off overweight and to dismiss it lightly. Doctors, however, regard it as a disease, and an insidious one at that. It is particularly treacherous because the fat person may *feel* fit as a fiddle for a long time. But he can depend on it that his years will be decreased in direct ratio to the number of extra pounds of fat he carries.

The back is directly affected by overweight, and as a preventive, as well as a curative, measure, anyone who has back troubles or who wishes to avoid them should watch those bathroom scales. After the age of thirty-five, everyone is better off when he's a few pounds underweight.

CHAPTER XVII

The Role of the Genitourinary System

The Feminine Angle

A woman is a creature with a pain in her back," said an advertisement once published by a corset manufacturer. Certainly backache is one of the most common complaints of women, and certainly, too, a large number of those backaches are due to the mere circumstance of being a woman. One investigator says that the pelvic organs may be blamed for one-third of feminine backaches.

Backaches due to gynecologic causes can be placed in three groups: (1) those caused by displacement of the uterus, (2) those caused by inflammations in the pelvic organs, and (3) tumors, particularly those which are imbedded in the pelvis or which are large enough to cause pressure.

Pregnancy often results in back pain, which may be either temporary or chronic. The bony framework of the pregnant woman's body undergoes great strain. The pelvic joints are separated and loosened in pregnancy and still more in labor. The ligaments supporting the uterus stretch and become relaxed. The weight of the baby places a heavy burden on the spinal column, which must support most of the weight, and intervertebral disk disorders frequently develop and produce backache. In most women such pelvic changes disappear soon after delivery, but in some, residual changes remain and cause chronic low-back pain.

In all these cases where backache is caused by pelvic disorders, it is the underlying disorder that needs treatment before the back. Close collaboration between the gynecologist and the orthopedic surgeon is necessary if such cases are to be fully understood and adequately treated.

The Masculine Viewpoint

Everyone knows about the backaches suffered by women as a result of injury to or infection in the reproductive organs, but few realize that men are just as prone to backache from disturbances in the male reproductive system. The prostate gland is the organ most often responsible for urologic backache in men, and the seminal vesicles are the next most prominent offenders. Pain in the *low* back, especially, is characteristic of many prostatic and seminal disorders. In fact, of 507 men who complained of backache and were examined by a group of investigators, 329 had genital disorders. Another author says that 80 per cent of low backache in men is due to the prostate and seminal vesicles.

The genital organs cause back pain in three ways: (1) by metastasis of infections or tumors, (2) by pouring poisons from focal infections into the blood stream, and (3) by reflex nervous impulses originating from pressure or adhesions. Pain is most commonly felt in the sacroiliac region and is called "lumbago" by the sufferer. The lower thoracic region is next in importance, and the upper thoracic region is least often painful. Characteristically, such pain is most pronounced in the morning, increases with the person's first movements after getting out of bed, and gradually improves with activity until the pain is relieved some-

time in the course of the day. Sexual excitation tends to increase the discomfort. The type of pain may vary. Sometimes it is an ache, a dull pain, soreness, stiffness, burning, a bearing-down sensation, a tired feeling, or a dragging sensation. It often follows the course of the sciatic nerve.

If the back condition is allowed to persist, it may cause changes in the spine and spinal treatment may be needed. If it is discovered early enough, treatment of the genital disorder alone by a urologist is usually sufficient to remove the backache. Prostatic and seminal vesicle infections generally require massage. Their secretions are expressed and then studied under the microscope. Weekly massage treatments should be continued until pus cells are reduced and active spermatozoa are seen again and until the spinal and other symptoms disappear. Focal infections in the tonsils, teeth, and sinuses should be looked for, because these often are spread through the blood stream to the genital tract. The prostate or seminal infection can never be cleared up so long as it is being constantly reinforced by poisons from the teeth or tonsils.

Cancer of the prostate, the most dangerous genital condition in men, may produce back pain by reflex nerve impulses, and, in its later stages, by metastasis to the spine. Prostatic cancer is particularly prone to metastasize to the bones, and the soft, spongy bones of the vertebrae are extremely vulnerable to it. If discovered early, prostatic cancer can be cured. If it has been allowed to metastasize, all the doctor can do is to try to control pain. Deep X-ray therapy will bring temporary relief, generally. Endocrine glands are helpful.

The Urinary Tract

An outstanding urologist has reported that of 3,000 patients treated for conditions of the urinary tract, 31 per cent complained of backache. Almost any kidney, ureteral, or bladder condition can cause backache, and sometimes confusion exists as to whether the condition requires a urologist or an orthopedic surgeon. A thoroughgoing physical examination, to reveal where the root of the trouble lies, is necessary.

The kidneys are located in the back, very close to the spine, at about the level of the lower thoracic and upper lumbar vertebrae. Consequently, in kidney infections pain most frequently occurs in the lower thoracic area of the back. Infection in a low-lying kidney or in the ureters or bladder is more likely to cause pain in the low back. Other urinary tract conditions that often produce back symptoms are stones and tumors in the kidney, bladder, or ureter, the tube that connects them.

Back pain due to urinary causes is deep-seated, rather than superficial. It is often described as a constant, dull ache, felt over a wide area, and the sufferer too frequently finds that it is not relieved by rest. Sometimes a "dragging" sensation is present. In many cases backache becomes more severe as the day progresses.

Incomplete drainage of the kidney, due to many possible causes, encourages infection and the formation of stones. Stones are particularly likely to develop in persons who are required to be bedfast for long periods of time. Pain in the ureters is most often caused by stones or by local inflammation, which obstruct the flow of urine and cause the ureteral muscles to contract spasmodically. Similarly, a tumor growing in the bladder may

obstruct the opening from the ureters, prevent entrance of the urine, and cause distention and pain because of retained urine in the upper part of the urinary tract.

Obviously, in these cases the urinary tract, and not the back, requires treatment. Once the kidney, bladder or ureteral difficulty is cleared up, the backache should disappear.

CHAPTER XVIII

The Back in Review

BACKACHE, as the reader has discovered by this time, means a discomfort that originates in or around the bones, joints, ligaments, muscles, connective tissues, nerves, and blood vessels of the back. Secondary backache means pain produced by or in some tissue or structure and referred to the back through the nerves. Flat feet, knock-knees, bowlegs, or tilted pelvis may produce secondary backache. So may focal infections in the gastrointestinal, genitourinary, or respiratory tracts.

The back problem is one of the most important in medicine and surgery, and the normal anatomy and physiology of the back are becoming increasingly important because of industrial, military, and civil injuries, and the insistence upon exact knowledge by industrial commissions, insurance companies, and the courts. The complex mechanism of the back and its many disorders are of great importance.

Early recognition of the causes of back disorders will minimize pain and disability and prevent or restore impaired usefulness. It is the patient's responsibility to seek medical advice promptly when back symptoms appear. The close cooperation of various specialists and orthopedic surgeons has added much information to the diagnosis of back troubles and makes the patient's outlook promising.

It is impossible to say that any one sign is positive proof of a certain disease or a lesion in any specific structure of the back. There is no one test that "makes or break" the diagnosis, and there is no one test that determines the exact location of a lesion

or injury. Instead, many tests must be used, the patient must give a careful history, and extensive X-ray pictures must be taken. Only after all this has been done can an accurate diagnosis be expected. Even then, differential diagnosis may be difficult. Similar symptoms may be produced by almost incredibly dissimilar causes.

The back is probably the seat of more abnormalities than any other part of the bony structure, producing symptoms, modifying the normal mechanics, and predisposing to stress, strain, weakness, and disease. Back injuries, even to normal spines, require longer periods of recovery than injuries to most joints.

The outlook in back disorders depends on the causative factors, the abnormal changes, duration of the condition, resistance of the patient, persistence of treatment, the question of financial or other compensation, and the degree of involvement of the spinal cord and nerves. Back injuries are sometimes followed by a train of nervous symptoms which are out of all proportion to the severity of the injury and which complicate the future recovery.

As in all other bodily disorders, however, the outlook in spinal conditions is more hopeful than it has ever been before. The newest antibiotic drugs, the latest techniques in anesthesia and surgery, the most modern X-ray and physical-therapy equipment, and the most carefully trained doctors are now at the service of the sufferer from backache. He can anticipate relief from pain and complete cure in disorders that a generation ago would have either chained him to his bed or put him out of his misery promptly.

Our time has been called "the golden age of therapeutics." Surely no one benefits more from living in this golden age than the person with a severe backache.

Glossary

A

abscess—a collection of pus, usually due to bacteria; contains white blood cells and other debris

acute—sudden, sharp

adhesion—union of tissues normally separate, due to formation of new tissue after inflammation or plastic exudate

alienation—a physiological, but not organic, interruption in the course of a nerve from its origin to the muscle it controls

anesthesia—complete lack of sensation or consciousness

annulus fibrosus—the laminated, onionskinlike outer portion of the intervertebral disk

anomaly—a deviation or departure from the normal; as, a "congenital anomaly"

arachnoid—one of the coverings of the spinal cord, lying between the dura mater and the pia mater

arachnoiditis—inflammation of the arachnoid membrane

arthritis—inflammation of a joint

arthrodesis—immobility of a joint

B

benign tumor—a nonmalignant tumor

biopsy—microscopic study of tissue during life, as an aid to diagnosis

bladder—a sac that contains the urine (urinary bladder)

bone graft—a surgical procedure in which normal bone is transplanted from one part of the body to another

C

calorie—the unit by which heat is measured

cancer—a malignant growth of tissue

caseation—change of tissue into a cheesy substance; seen in vertebral infections, such as tuberculosis

cauda equina—the taillike termination of the spinal cord

caudal—pertaining to a tail; situated in or near that end of the body

cervical—pertaining to the neck

chronic—continuing for a long time; a disease or condition of long duration

coccyx—the terminal boné of the spinal column; the "tail bone"

concussion—a condition in which the function of an organ is lowered without visible structural change; caused by a shock or injury

congenital—existing at, or dating from, birth; acquired during development in the uterus

contusion—a bruise; the rupturing of blood vessels, producing hemorrhage underneath the skin; may be superficial or deep

conus medullaris—the lower end of the spinal cord, situated at the lower level of the first lumbar vertebra, immediately above the *cauda equina*

D

diathermy—a physical-therapy measure by which the tissues are heated by means of high-frequency electric current

dislocation—displacement of a bone from its normal connections with a neighboring bone; disjunction (synonym: luxation)

dorsal—pertaining to, or toward, the back

dura mater—the tough, outer membrane enveloping the spinal cord

dural sac—the membranes that enclose the dura

E

electrotherapy—a physical-therapy measure in which the electric current is used for treatment

endocrine glands—the glands of internal secretion; as, the thyroid

etiological factors—the causes of disorders

etiology—the study of the causes of disorders

express—press or squeeze out; as, express fluid from the prostate gland

F

fetus—an infant developing in the uterus; called an embryo up to the third month

flex—bend

foramen—the opening formed by the spinal arch and through which a spinal nerve passes (plural: foramina)

fracture—a break, as of a bone

fusion—a procedure in which normally jointed bones are fused by disease or surgery to prevent movement

G

gastrointestinal tract—the parts of the digestive tract that include the stomach and intestines

genitourinary tract—the parts of the body that include the urinary and genital organs

gynecology—the branch of medicine that studies and treats the diseases and disorders of women

H

heliotherapy—a physical-therapy measure in which the sun's rays are used in treatment

hernia—an unnatural protrusion of an organ, or part of an organ, through its normal walls

histology—the branch of medicine that studies tissue structure

history—the story of present and past symptoms and conditions as related by a patient

hyperesthesia—excessive sensibility

hypesthesia—decreased sensibility

I

intervertebral disk—the cushion placed between each two vertebrae and composed of an elastic center, the *nucleus pulposus*, and a tough, covering membrane, the *annulus fibrosus*; its function is to absorb shock and to render the spine more flexible; it increases the length of the spine

K

kidney—one of two glands situated in the back near the spinal column and serving to excrete waste products in urine

kyphos—an abnormal backward angulation of the spinal column; "a hump"

L

lamina—part of the vertebra projecting from its body

laminectofusion—a surgical procedure in which laminectomy and fusion are combined

laminectomy—a surgical procedure in which the spinal cord or its meninges are exposed

lateral—to the side

lesion—any change in a body structure caused by disease

ligament—a tough band of tissue that supports a joint or an organ

localized pain—pain that is limited to the area of disease or injury

lordosis—forward curving of a section of the spinal column

lumbago—a term applied to pain in the lower back; really a pain and spasm of back muscles

lumbar—pertaining to the lowest forward curve of the spine, the loin

lymph node—a glandlike structure that secretes lymph, a fluid con-

sisting chiefly of blood plasma and colorless corpuscles; diseases, particularly cancer, may be spread by means of the lymph system

M

malignant tumor—cancer

medulla oblongata—the lowest segment of the brain, to which the spinal cord is joined

meninges—the membrane coverings of the spinal cord; the pia, arachnoid, and dura

meningitis—inflammation of the meninges

metabolism—the sum of the processes by which living cells are changed chemically to provide energy for life and new material for bodily repair (anabolism = building up; catabolism = breaking down)

metastasis—the transfer of a disease or abnormal condition from one part of the body to another, as in cancer

myelitis—inflammation of the spinal cord or bone marrow

N

nerve—a cordlike band of tissue that connects parts of the nervous system with other organs and conducts nerve impulses

nerve root—a bundle of nerve fibers that attaches a nerve to the spinal cord

neuralgia—pain in a nerve or in the area along its course, without inflammation or interference with the nerve's functioning

neuritis—inflammation of a nerve

neurology—the branch of medicine that studies and treats the nerves and the nervous system

nucleus pulposus—the inner, semi-elastic tissue of the intervertebral disk

O

obesity—overweight

occipitalization—a congenital anomaly in which the first cervical vertebra has merged with the occiput, or back of the skull

occupational therapy—the "science of prescribed work," in which a patient is taught to do certain work that will strengthen a muscle or function weakened by disease or injury

orthopedic surgery—the branch of medicine that studies and treats the bones and joints, their muscles, nerves, ligaments, and blood vessels

P

paraplegia—paralysis of the lower part of the body

pelvis—the basinlike structure of the human skeleton to which the spinal column and thigh bones are joined

phototherapy—a physical-therapy measure in which lights are used

physical medicine—new term for physical therapy

physical therapy—treatment of disease by physical and mechanical means

pia mater—the innermost membrane covering the spinal cord

poker back—an abnormal condition in which spinal curves are obliterated, producing a flat, stiff back

poliomyelitis—inflammation of the gray matter of the spinal cord, often producing paralysis due to degeneration of the nerve cells; infantile paralysis

Pott's disease—tuberculosis of the spine

primary tumor—the first tumor to appear in the body

prognosis—prediction of the outcome of a disease or injury

prostate—a male reproductive gland that secretes a fluid in which spermatozoa are carried

psychosomatic medicine—the branch of medicine in which the body and mind are considered as a unit and in which the effects of the emotions on organic illness, and vice versa, are studied

R

rachischisis—a rare congenital anomaly in which all or a large part of the vertebral column is split and the spinal cord exposed

radiculitis—inflammation or irritation of the nerve roots

referred pain—the transfer of pain from a diseased or injured area that is insensitive to an area that is very sensitive

reflex—an involuntary transfer of nervous impulses

rheumatism—a condition characterized by pain and stiffness of the joints or muscles

roentgenogram—X-ray picture, from the name of Konrad Roentgen, the discoverer of X rays

rupture—a hernia; a break through normal boundaries

S

sacroiliac joint—the joint connecting the spinal column with the pelvis; there is one on each side of the sacrum

sacrum—the lowest part of the spinal column, immediately above the coccyx

sciatica—pain along the course of the sciatic nerve

sclerosis—replacement of normal tissue with denser tissue

scoliosis—lateral curvature of the spine

secondary tumor—a tumor resulting from metastasis of a primary tumor

seminal vesicle—a male reproductive organ that contains semen

silhouettograph—a photograph taken through a screen, so that the body appears as a silhouette; used in diagnosing postural disorders

spasm—an involuntary and unnatural muscle contraction

spina bifida—a congenital anomaly in which the vertebrae have failed to join properly and in which portions of the spinal cord may protrude from the resulting vertebral clefts

spina bifida occulta—a common congenital anomaly in which the vertebrae have failed to join properly, resulting in a cleft (similar to cleft plate)

spinal arch—a portion of the vertebra that forms the vertebral foramen

spinal cord—the cord of nerve tissue extending from the brain through the spinal canal from which the spinal nerves proceed; the human switchboard

spinous process—the center, fingerlike projection of a vertebra

sprain—a condition in which the ligaments are suddenly torn from their attachment to the bones of a joint; caused by a twist or wrench

stereognosis—the ability to correlate and interpret varying sensory impressions

stilbesterol—a female hormone

strain—an injury to muscle or ligament, occurring when excessive force is applied

syringomyelia—a chronic disease of the spinal cord

T

thoracic—referring to the area of the spine immediately below the cervical, that is, the chest and upper back

toxin—poison

traction—the act of pulling

transverse process—the lateral, fingerlike projections of a vertebra

tumor—an abnormal mass of tissue; a swelling

U

ureter—one of two tubes that conduct urine from the kidneys to the bladder

urethra—the canal which carries off urine from the bladder and which in the male serves as a genital duct

urology—the branch of medicine that treats and studies conditions of the genitourinary system

uterus—the female organ where a fetus is contained and nourished before birth

V

ventral—toward the abdomen

vertebra—a bone, one of the constituents of the spinal column, and consisting of a body, a spinal arch, and spinous and transverse processes

X

X ray—any of the radiations of the same nature as light radiation, but of an extremely short wave length, emitted primarily as the result of a sudden change in the velocity of a moving electric charge and as the result of changes in the atoms of the target due to this impact

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